# Marine fish and invertebrate atlas: geographic distribution, population indices and environmental associations of marine species in the Scotian Shelf and Bay of Fundy derived from the annual Maritimes summer survey (1970-2020)

Daniel Ricard, Catalina Gomez, Jamie Emberley, Catriona Regnier-McKellar and Ryan Martin

Science Branch - Gulf Region
Fisheries and Oceans Canada
Moncton, New Brunswick, E1C 5K4, Canada

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# MARINE FISH AND INVERTEBRATE ATLAS: GEOGRAPHIC DISTRIBUTION, POPULATION INDICES AND ENVIRONMENTAL ASSOCIATIONS OF MARINE SPECIES IN THE SCOTIAN SHELF AND BAY OF FUNDY DERIVED FROM THE ANNUAL MARITIMES SUMMER SURVEY (1970-2020)

by

Daniel Ricard [1] Catalina Gomez [2] Jamie Emberley [3] Catriona Regnier-McKellar [3] Ryan Martin [3]

[1]Science Branch - Gulf Region
Fisheries and Oceans Canada
Moncton, New Brunswick, E1C 5K4, Canada
[2]Science Branch - Maritimes Region
Fisheries and Oceans Canada
Dartmouth, Nova Scotia, B2Y 4A2, Canada
[3]Science Branch - Maritimes Region
Fisheries and Oceans Canada
St. Andrews, New Brunswick, E5B 0E4, Canada

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## ABSTRACT

Ricard, D., Gomez, C., Emberley, J., Regnier-McKellar, C. and Martin, R. 2022. Marine fish and invertebrate atlas: geographic distribution, population indices and environmental associations of marine species in the Scotian Shelf and Bay of Fundy derived from the annual Maritimes summer survey (1970-2020). Can. Tech. Rep. Fish. Aquat. Sci. 3498: viii + 193 p.

The summer research vessel survey on the Scotian Shelf bioregion started in 1970 and was designed to measure the distribution and abundance of major commercial and non-commercial species. This report builds on previous work and former atlases by updating a comprehensive suite of indices to assess population status and environmental associations of 103 species. For each species, trends in geographic distribution and biomass were plotted. The spatial extent of distribution was plotted over time to gauge changes in the area occupied. The relationship between abundance or biomass and spatial extent reflected whether the species distribution expands when biomass increases. Length frequencies over time depicted any changes in mean size. The plots of condition over time revealed whether individual fish are fatter or thinner than their long term mean. Depth, temperature and salinity associations were estimated to gauge the range of suitable environmental parameters for each species. Finally, for each stratum, the slope describing how local density varies with regional abundance was estimated. The reproducible set of tools provided in this report constitutes a stepping stone to conduct other ecological analyses using the summer groundfish research vessel survey data by fostering reproducibility and transparency of ecological information collected and reported annually.

**RÉSUMÉ**

Ricard, D., Gomez, C., Emberley, J., Regnier-McKellar, C. and Martin, R. 2022. Marine fish and invertebrate atlas: geographic distribution, population indices and environmental associations of marine species in the Scotian Shelf and Bay of Fundy derived from the annual Maritimes summer survey (1970-2020). Can. Tech. Rep. Fish. Aquat. Sci. 3498: viii + 193 p.

Le relevé estival par navire de recherche dans la biorégion du plateau néo-écossais a débuté en 1970 et visait à mesurer la répartition et l'abondance des principales espèces commerciales et non commerciales. Ce rapport s'appuie sur des travaux antérieurs et d'anciens atlas en mettant à jour une série complète d'indices pour évaluer l'état de la population et les associations environnementales de 103 espèces. Pour chaque espèce, les tendances de la répartition géographique et de la biomasse ont été tracées. L'étendue spatiale de la distribution a été tracée au fil du temps pour évaluer les changements dans la zone occupée. La relation entre l'abondance ou la biomasse et l'étendue spatiale indique si la répartition des espèces s'étend lorsque la biomasse augmente. Les fréquences de longueur au fil du temps représentaient tout changement dans la taille moyenne. Les graphiques de condition au fil du temps ont révélé si les poissons sont plus gros ou plus minces que leur moyenne à long terme. Les associations de profondeur, de température et de salinité ont été estimées pour évaluer la gamme de paramètres environnementaux appropriés pour chaque espèce. Enfin, pour chaque strate, la pente décrivant comment la densité locale varie avec l'abondance régionale a été estimée. L'ensemble d'outils reproductibles fournis dans ce rapport constitue un tremplin pour effectuer d'autres analyses écologiques à l'aide des données du relevé d'été des navires de recherche sur les poissons de fond en favorisant la reproductibilité et la transparence des informations écologiques recueillies et présentées annuellement.

# 1 Introduction

The summer (July-August) groundfish research vessel survey on the Scotian Shelf and in the Bay of Fundy was started in 1970 by Fisheries and Oceans Canada Maritimes Region. The survey was originally designed to measure the distribution and abundance of major commercial fish species. Over time, information on non-commercial species was also collected. The annual groundfish survey provides the main source of fisheries-independent information for marine species in the region. This information is available through database storing the information collected during the annual survey and is routinely used to support stock assessments, to produce species status reports, and has been previously used to publish atlases of species distribution.

This document is an update of an earlier report (Ricard and Shackell 2013) that built on former atlases by updating a comprehensive suite of derived indices for 103 species to assess population status and, when feasible, environmental preferences. The information collected during the survey is stored in a relational database management system archived at Fisheries and Oceans Canada Maritimes Region which contains detailed information about the sampling locations and the associated catch. Tow-level survey data is also publicly available from the Ocean Biogeographic Information System (DFO 2016) and from the Open data portal supported by the federal government (DFO 2021). The present atlas builds upon the work done by Fisheries and Oceans colleagues from the northern Gulf of St. Lawrence (Bourdages and Ouellet 2012), southern Gulf of St. Lawrence (Benoît et al. 2003) and on earlier work in the Scotian Shelf (Simon and Comeau 1994; Horsman and Shackell 2009).

All the necessary components required to assemble the current document are made available in a Git repository (Ricard and Gomez 2022). This step is deemed necessary to facilitate updates and to foster collaboration on further analyses of the available survey data. All the computer code necessary to extract the data and to perform the analyses presented herein is available from the git repository. We hope that this step will help to reproduce, update, and, undoubtedly, correct the results presented in the current report.

The survey area covers three major Northwest Atlantic Fisheries Organization (NAFO) zones that divide the Scotian Shelf into the colder east 4V and 4W (strata 440-466) and warmer west 4X (strata 470-495). For each species, temporal trends in geographic distribution and, when possible, biomass are plotted. Some caution is required in interpreting the results obtained for several taxa due to low sample size, as explained later in the text. A full ecological interpretation of trends is beyond the scope of this report. Other documents stemming from peer-reviewed scientific processes under the auspices of the Canadian Science Advisory Secretariat (CSAS) provide further descriptions of spatio-temporal trends in different indicators, and place the information collected during the summer groundfish research vessel survey in a more focused context, see for example Clark and Emberley (2011).

# 2 Methods

## 2.1 Survey Description

The survey is conducted annually in July-August and covers the Scotian Shelf and the Bay of Fundy (Figure 1). It normally involves at least two separate trips on board an offshore fisheries vessel from the Canadian Coast Guard for a total duration of around 6 weeks at sea.

The fishing platform used (the vessel and the type of fishing gear) has changed a number of times since the onset of sampling activities (Clark and Emberley 2011). Comparative fishing experiments were conducted when those changes in survey platforms took place (Koeller and Smith 1983; Fanning 1984; Fanning 1985; Fowler and Showell 2009). The A.T. Cameron using a Yankee 36 trawl was the primary survey vessel from 1970 to 1981. The vessel that was then built to replace the A.T. Cameron to conduct trawl surveys (CCGS Alfred Needler) was not yet operational and the Lady Hammond was used to bridge the gap between the A.T. Cameron and the CCGS Alfred Needler. A change to the Western IIA trawl also took place after A.T. Cameron was retired. The CCGS Alfred Needler entered service for the 1983 summer survey using a Western IIA trawl. It has been the main survey platform since. The CCGS Alfred Needler suffered a fire in late August 2003 and was still not available to conduct the survey in 2004, so CCGS Teleost was used instead. In 2007, 2008 and 2018 the CCGS Alfred Needler was not available and the survey was conducted on the CCGS Teleost in 2007 and 2018, and on the CCGS Wilfred Templeman in 2008. The relevant details of the survey vessels (Maginley et al. 2014) and fishing trawls (Fanning 1985) used can be found in Table 1 and a timeline of the survey platforms can be found in Figure 2. In 2018, because of the unavailability of the CCGS Alfred Needler, only a partial survey coverage was achieved on CCGS Teleost, and most of the strata in NAFO Division 4VW were not sampled. As such, while the limited 2018 data are available, they are not used in the analyses present herein since estimates derived using the 2018 data will not be comparable to other years.

Table 1. Details about the vessels and trawls used over the lifetime of the summer survey.

| Name | Measurements | Description |
|---|---|---|
| **Survey vessels** | | |
| A.T. Cameron | Length: 53.0m<br>Gross tonnage: 735 t | Main survey vessel from 1970 to 1981 |
| Lady Hammond | Length: 58.0m<br>Gross tonnage: 897 t | Vessel used in 1982 and 1983 to bridge between the A.T. Cameron and the CCGS Alfred Needler |
| CCGS Alfred Needler | Length: 50.3m<br>Gross tonnage: 959 t | Main survey vessel since 1983 |
| CCGS Wilfred Templeman | Length: 50.3m<br>Gross tonnage: 959 t | Sister ship of CCGS Alfred Needler, used in 2008 |
| CCGS Teleost | Length: 63.0m<br>Gross tonnage: 2,405 t | Used in 2007 and 2018 |
| **Fishing trawls** | | |
| **Name** | **Measurements** | **Description** |
| Yankee 36 | Wing spread: 10.7m<br>Headline height: 2.74m | Used on the A.T. Cameron from 1970 to 1982 |
| Western IIA | Wing spread: 12.5m<br>Headline height: 4.6m | Used since 1983 |

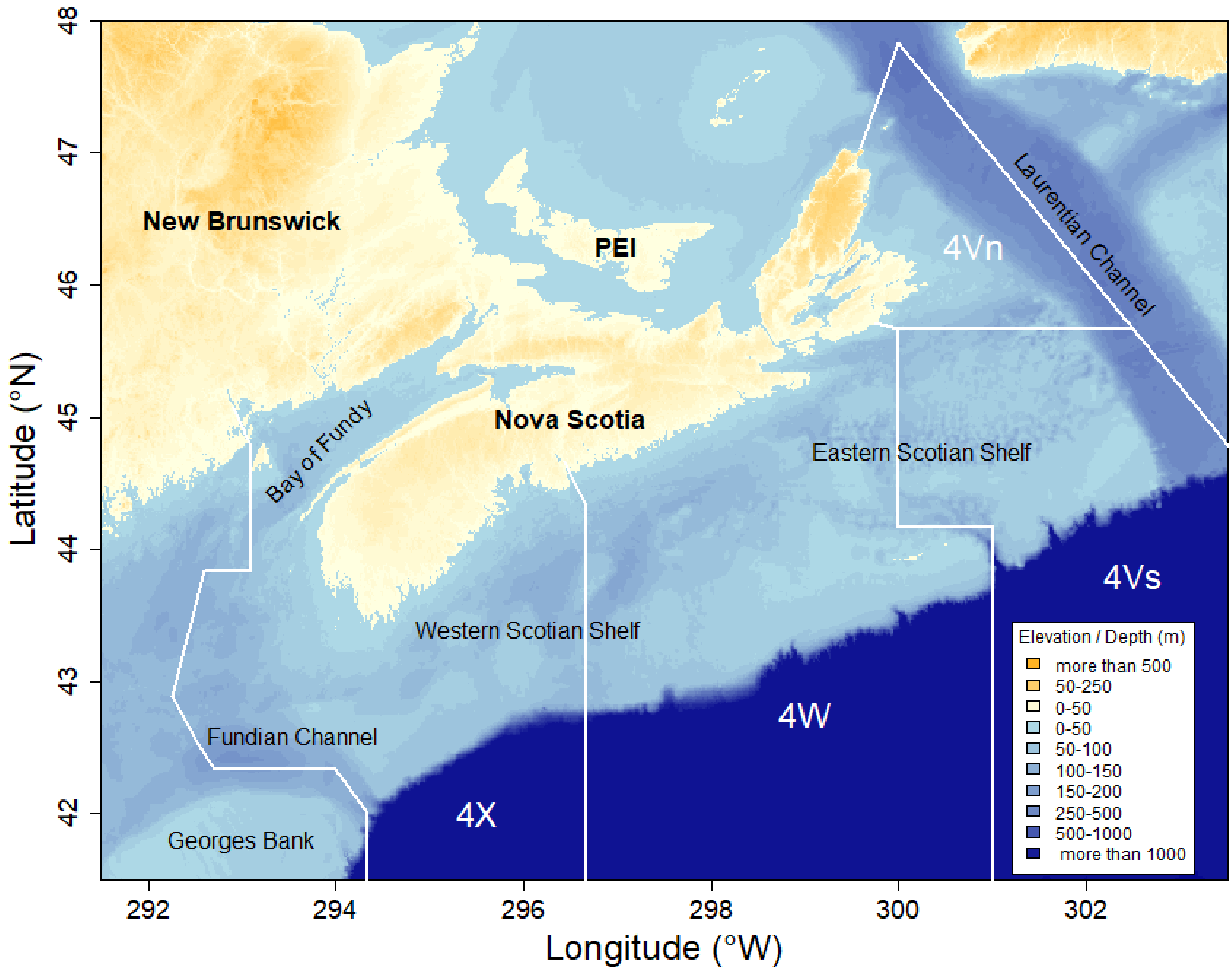


Figure 1. Map of the Scotian Shelf and Bay of Fundy where the DFO Maritimes summer survey takes place. The bathymetry presented here is the 15 arc-second gridded data set from the General Bathymetric Chart of the Oceans (GEBCO). Geographical locations of interest and the boundaries of relevant NAFO Divisions are also shown on the map.

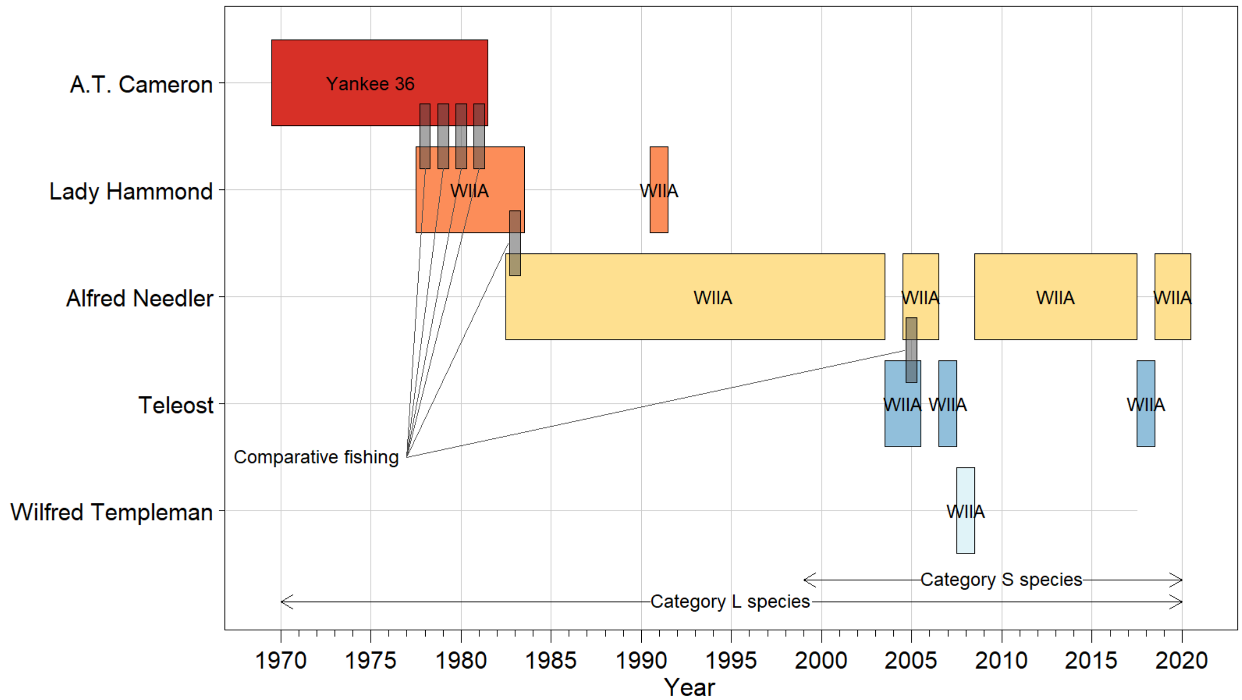


Figure 2. Timeline of survey platforms used in the Maritimes Region summer survey. The x axis denotes the timespan of the survey. The y axis identifies the vessel on which survey sets were conducted. The type of fishing gear deployed is overlaid on the rectangles representing the time window when each vessel was used (WIIA is the Western IIA trawl). Comparative fishing experiments are identified by gray polygons overlapping the survey platforms under comparison. The timespan where categories L and S species (see Section 2.3) were consistently recorded appears on the bottom of the figure.

## 2.2 Sampling Design

The summer survey covers divisions 4V, 4W and 4X of the Northwest Atlantic Fisheries Organization (NAFO), which includes the Scotian Shelf and the Bay of Fundy. The eastern limit of the survey is the Laurentian Channel and the western limit is the Fundian Channel (Figure 1).

The survey follows a stratified random design (Doubleday and Rivard 1981; Lohr 1999) (Figure 3). The number of tows conducted in each stratum is approximately proportional to the surface area of the stratum. The targeted area covered by the survey has remained constant since its inception, with the exception of 1) additional deeper strata that were sampled a few times since 2000 and 2) some opportunistic coverage of the eastern portion of Georges Bank since 2011. Because the sampling of both the deeper strata and the eastern portion of Georges Bank is opportunistic and irregular, the analyses presented herein only include strata 440 to 466, 470 to 478, 480 to 485, and 490 to 495, which cover NAFO Divisions 4V, 4W and 4X (Figure 3 and Table 2). Strata 443, 444, 445 cover an area with mixed depths and are represented as a single polygon in Figure 3.

The basic sampling unit of the survey is a 30-minute fishing tow conducted at a speed of 3.5

knots. This yields a distance towed of 1.75 nautical miles.

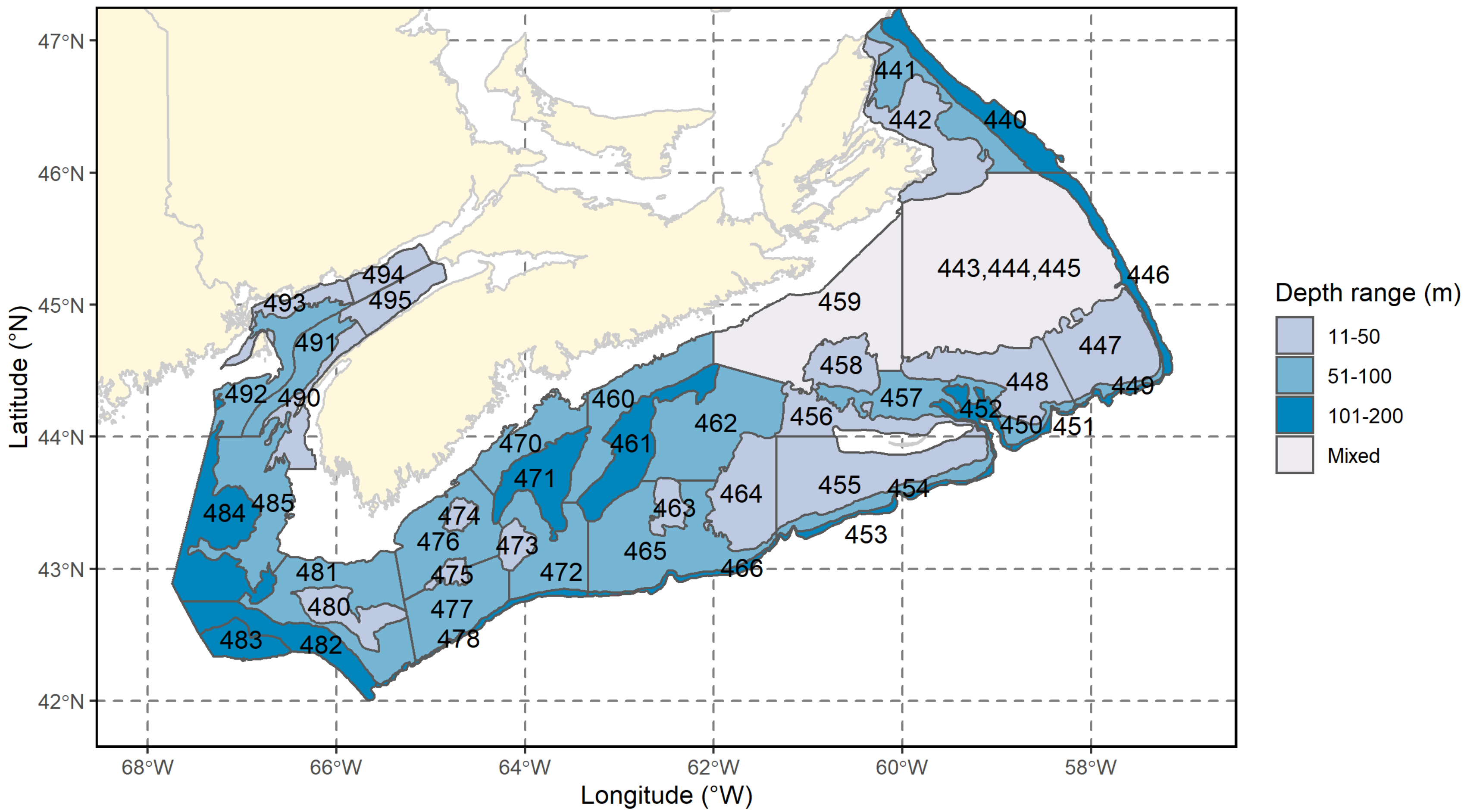


Figure 3. Map of the DFO Maritimes summer survey strata 440 to 495.

Table 2. Summer survey strata details. The strata used in the analyses are presented separately for NAFO Divisions 4Vn, 4VsW and 4X. For each stratum, the depth range is reported in fathoms and in meters, and the surface area is reported in square nautical miles and in square kilometers.

| NAFO Div. | Stratum | Depth range (fathom) | Depth range (meter) | Area (nm $^2$) | Area (km $^2$) |
|---|---|---|---|---|---|
| 4Vn | 440 | 101-200 | 185-366 | 924 | 3,169 |
| | 441 | 51-100 | 93-183 | 1,000 | 3,430 |
| | 442 | 11-50 | 20-91 | 1,437 | 4,929 |
| 4VsW | 443 | 11-50 | 20-91 | 1,318 | 4,521 |
| | 444 | 51-100 | 93-183 | 3,925 | 13,462 |
| | 445 | 101-200 | 185-366 | 1,023 | 3,509 |
| | 446 | 101-200 | 185-366 | 491 | 1,684 |
| | 447 | 11-50 | 20-91 | 1,616 | 5,543 |
| | 448 | 11-50 | 20-91 | 1,449 | 4,970 |
| | 449 | 51-100 | 93-183 | 144 | 494 |
| | 450 | 51-100 | 93-183 | 383 | 1,314 |
| | 451 | 101-200 | 185-366 | 147 | 504 |
| | 452 | 101-200 | 185-366 | 345 | 1,183 |
| | 453 | 101-200 | 185-366 | 259 | 888 |
| | 454 | 51-100 | 93-183 | 499 | 1,712 |
| | 455 | 11-50 | 20-91 | 2,122 | 7,278 |
| | 456 | 11-50 | 20-91 | 955 | 3,276 |
| | 457 | 51-100 | 93-183 | 811 | 2,782 |
| | 458 | 11-50 | 20-91 | 658 | 2,257 |
| | 459 | 11-50 | 20-91 | 3,148 | 10,797 |
| | 460 | 51-100 | 93-183 | 1,344 | 4,610 |
| | 461 | 101-200 | 185-366 | 1,154 | 3,958 |
| | 462 | 51-100 | 93-183 | 2,116 | 7,258 |
| | 463 | 11-50 | 20-91 | 302 | 1,036 |
| | 464 | 11-50 | 20-91 | 1,297 | 4,449 |
| | 465 | 51-100 | 93-183 | 2,383 | 8,173 |
| | 466 | 101-200 | 185-366 | 226 | 775 |

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| NAFO Div. | Stratum | Depth range (fathom) | Depth range (meter) | Area (nm $^2$) | Area (km $^2$) |
|---|---|---|---|---|---|
| | 470 | 51-100 | 93-183 | 920 | 3,156 |
| | 471 | 101-200 | 185-366 | 1,004 | 3,444 |
| | 472 | 51-100 | 93-183 | 1,249 | 4,284 |
| | 473 | 11-50 | 20-91 | 265 | 909 |
| | 474 | 11-50 | 20-91 | 161 | 552 |
| | 475 | 11-50 | 20-91 | 156 | 535 |
| | 476 | 51-100 | 93-183 | 1,478 | 5,069 |
| | 477 | 51-100 | 93-183 | 1,232 | 4,226 |
| | 478 | 101-200 | 185-366 | 233 | 799 |
| | 480 | 11-50 | 20-91 | 655 | 2,247 |
| 4X | 481 | 51-100 | 93-183 | 1,875 | 6,431 |
| | 482 | 101-200 | 185-366 | 1,042 | 3,574 |
| | 483 | 101-200 | 185-366 | 532 | 1,825 |
| | 484 | 101-200 | 185-366 | 2,264 | 7,765 |
| | 485 | 51-100 | 93-183 | 1,582 | 5,426 |
| | 490 | 11-50 | 20-91 | 601 | 2,061 |
| | 491 | 51-100 | 93-183 | 687 | 2,356 |
| | 492 | 51-100 | 93-183 | 1,086 | 3,725 |
| | 493 | 11-50 | 20-91 | 533 | 1,828 |
| | 494 | 11-50 | 20-91 | 417 | 1,430 |
| | 495 | 11-50 | 20-91 | 584 | 2,003 |
| Total | | | | 50,032 | 171,606 |

After each tow the catch is sorted by species and weighed. Each fish caught is then measured, and further sampling of individual fish weight, maturity status and age are performed for different length classes. When catches exceed 300 individuals, a random sub-sample is used to obtain the length and weight measurements.

### 2.3 Taxonomic Levels

Fish species caught during the surveys are identified by trained scientific personnel and their scientific name is determined. An internal species code used in the relational database is reported for each species (Losier and Waite 1989). There are a few instances where a number of species are assigned to a single species code (e.g. *Sebastes* and *Myctophidae* species).

By its nature as a bottom trawl, the fishing gear used in the survey catches certain species better than others. To ensure that meaningful ecological information can be extracted from catch samples, we report the catch records for the subset of species that are caught reliably by the gear. To appear in this atlas, a species must have been observed a minimum of 10 times over the duration of the survey activities. While both catch abundance and weight are recorded, the weight of species that appear at low abundances is often recorded as zero in the earlier parts of the survey when scales of appropriate precision were not available. Another important factor to consider when analyzing weights is the change from spring scales to electronic balances that occurred in the 1990s. This change will affect the error structure of weight observations but should not introduce a bias in the measurements.

We divided the species caught into six categories based on 1) their taxonomic classification, 2) the number of recorded observations (i.e. the number of sets were a species was recorded), and 3) their period of valid identification (Table 3). Category ”LF”, for ”long frequent”, was assigned to species that have been caught in more than 1,500 sets since 1970 and have been consistently identified since the onset of the survey. Category ”LI”, for ”long intermediate”, was assigned to species that were caught in 1,500 to 200 sets. Category ”LIn”, for ”long intermediate, using catch numbers”, was assigned to species that were caught in 200 to 1,500 sets but whose weights were not consistently recorded over the duration of the survey. Rare and elusive species (those caught in less than 200 sets over the duration of the survey) are also reported but to a lower level of analytical details (Category ”LR”, for ”long rare”). Category ”SF”, for ”short frequent”, was assigned to invertebrate species that were consistently sampled only since 1999 (Tremblay et al. 2007). Finally, category ”SR”, for ”short rare”, for invertebrate species consistently sampled only since 1999 and caught in less than 200 sets. Note that a number of other species are episodically caught in the survey, but are omitted from this report because their low catchability by trawl gear makes them unsuitable for analyses. To ensure concordance with authoritative taxonomic information, the AphiaID from the World Register of Marine Species (Appeltans et al. 2012) is included for the different species presented in this document (Table 4) .

Table 3. Taxonomic levels used to determine the analytical treatment for each species.

| **Category** | **Name** | **Description** |
|---|---|---|
| L | long - consistently identified since the onset of the survey in 1970 | |
| LF | long frequent | species that have more than 1,500 catch records |
| LI | long intermediate | species that had between 200 and 1,500 catch records |
| LIn | long intermediate, using catch numbers | species that had between 200 and 1,500 catch records, but whose catch weights were not consistently recorded |
| LR | long rare | species with less than 200 catch records |
| S | short - invertebrate species that were consistently sampled only since 1999 | |
| SF | short frequent | species with more than 200 catch records |
| SR | short rare | species with less than 200 catch records |

Table 4. List of the 103 species included in the Atlas. For each taxonomic order and class, each species is listed in the table, its taxonomic family and scientific name are provided, along with its French and English common names, the species code used in the survey database with a link to the associated section in the document, its AphiaID with a link to the World Register of Marine Species, its number of catch records in the survey database and its classification category as defined in section 2.3.

| Family | Scientific name | English name | French name | Species code | AphiaID | Num. records | Category |
|---|---|---|---|---|---|---|---|
| **Class: Myxini** | | | | | | | |
| *Order: Myxiniformes* | | | | | | | |
| Myxinidae | Myxine glutinosa | Atlantic hagfish | Myxine du nord | 241 | 101170 | 804 | LI |
| **Class: Petromyzonti** | | | | | | | |
| *Order: Petromyzontiformes* | | | | | | | |
| Petromyzontidae | Petromyzon marinus | Sea lamprey | Lamproie marine | 240 | 101174 | 16 | LR |
| **Class: Actinopterygii** | | | | | | | |
| *Order: Anguilliformes* | | | | | | | |
| Nemichthyidae | Nemichthys scolopaceus | Slender snipe eel | Avocette ruban | 604 | 126306 | 28 | LR |
| *Order: Argentiniformes* | | | | | | | |
| Argentinidae | Argentina silus | Greater argentine | Grande argentine | 160 | 126715 | 963 | LI |
| *Order: Aulopiformes* | | | | | | | |
| Chlorophthalmidae | Chlorophthalmus agassizi | Shortnose greeneye | Éperlan du large | 156 | 126336 | 78 | LR |
| | Parasudis truculenta | Longnose greeneye | Oeil-vert à long nez | 149 | 158868 | 45 | LR |
| Paralepididae | Arctozenus risso | White barracudina | Lussion blanc | 712 | 126352 | 196 | LR |
| *Order: Beloniformes* | | | | | | | |
| Scomberesocidae | Scomberesox saurus | Atlantic saury | Balaou atlantique | 720 | 126392 | 37 | LR |
| *Order: Clupeiformes* | | | | | | | |
| Clupeidae | Alosa pseudoharengus | Alewife | Gaspareau | 62 | 158669 | 977 | LI |
| | Alosa sapidissima | American shad | Alose savoureuse | 61 | 158670 | 468 | LI |
| | Clupea harengus | Atlantic herring | Hareng de l'Atlantique | 60 | 126417 | 3,487 | LF |
| *Order: Gadiformes* | | | | | | | |

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| Family | Scientific name | English name | French name | Species code | AphiaID | Num. records | Category |
|---|---|---|---|---|---|---|---|
| Gadidae | Gadus morhua | Atlantic cod | Morue franche | 10 | 126436 | 5,451 | LF |
| | Melanogrammus aeglefinus | Haddock | Aiglefin | 11 | 126437 | 5,827 | LF |
| | Microgadus tomcod | Atlantic tomcod | Poulamon atlantique | 17 | 158928 | 44 | LR |
| | Pollachius virens | Pollock | Goberge | 16 | 126441 | 2,787 | LF |
| Lotidae | Brosme brosme | Cusk | Brosme | 15 | 126447 | 688 | LI |
| | Enchelyopus cimbrius | Fourbeard rockling | Motelle à quatre barbillons | 114 | 126450 | 693 | LI |
| Macrouridae | Coryphaenoides rupestris | Roundnose grenadier | Grenadier de roche | 414 | 158960 | 17 | LR |
| | Nezumia bairdii | Marlin-spike grenadier | Grenadier du Grand Banc | 410 | 183289 | 529 | LI |
| | Trachyrincus murrayi | Roughnose grenadier | Grenadier-scie | 412 | 126481 | 18 | LR |
| Merlucciidae | Merluccius albidus | Offshore silver hake | Merlu argenté du large | 19 | 158748 | 161 | LR |
| | Merluccius bilinearis | Silver hake | Merlu argenté | 14 | 158962 | 4,936 | LF |
| Phycidae | Phycis chesteri | Longfin hake | Merluche à longues nageoires | 112 | 158988 | 784 | LI |
| | Urophycis chuss | Red hake | Merluche écureuil | 13 | 126503 | 2,195 | LF |
| | Urophycis tenuis | White hake | Merluche blanche | 12 | 126504 | 3,524 | LF |
| *Order: Lophiiformes* | | | | | | | |
| Lophiidae | Lophius americanus | Monkfish | Baudroie d'Amérique | 400 | 159184 | 1,970 | LF |
| Ogcocephalidae | Dibranchus atlanticus | Atlantic batfish | Malthe atlantique | 742 | 126558 | 18 | LR |
| *Order: Myctophiformes* | | | | | | | |
| Myctophidae | Myctophidae | Lanternfishes | Poissons-lanternes | 150 | 125498 | 160 | LR |
| *Order: Osmeriformes* | | | | | | | |
| Osmeridae | Mallotus villosus | Capelin | Capelan | 64 | 126735 | 540 | LIn |
| | Osmerus mordax | Rainbow smelt | Éperlan arc-en-ciel | 63 | 126737 | 59 | LR |
| *Order: Perciformes* | | | | | | | |

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| Family | Scientific name | English name | French name | Species code | AphiaID | Num. records | Category |
|---|---|---|---|---|---|---|---|
| Ammodytidae | Ammodytes dubius | Sand lance | Lançon | 610 | 151520 | 1,283 | LIn |
| Anarhichadidae | Anarhichas denticulatus | Northern wolffish | Loup à tête large | 52 | 126757 | 17 | LR |
| | Anarhichas lupus | Atlantic wolffish | Loup atlantique | 50 | 126758 | 1,572 | LF |
| | Anarhichas minor | Spotted wolffish | Loup tacheté | 51 | 126759 | 20 | LR |
| Callionymidae | Foetorepus agassizii | Spotfin dragonet | Dragonnet tacheté | 637 | 276339 | 20 | LR |
| Cryptacanthodidae | Cryptacanthodes maculatus | Wrymouth | Terrassier tacheté | 630 | 159675 | 120 | LR |
| Labridae | Tautogolabrus adspersus | Cunner | Tanche-tautogue | 122 | 159785 | 82 | LR |
| Pholidae | Pholis gunnellus | Rock gunnel | Sigouine de roche | 621 | 126996 | 21 | LR |
| Scombridae | Scomber scombrus | Atlantic mackerel | Maquereau commun | 70 | 127023 | 696 | LI |
| Stichaeidae | Eumesogrammus praecisus | Fourline snakeblenny | Quatre-lignes atlantique | 626 | 159817 | 40 | LR |
| | Leptoclinus maculatus | Daubed shanny | Lompénie tachetée | 623 | 127072 | 443 | LIn |
| | Lumpenus lampretaeformis | Snakeblenny | Lompénie-serpent | 622 | 154675 | 423 | LIn |
| | Ulvaria subbifurcata | Radiated shanny | Ulvaire deux-lignes | 625 | 159821 | 145 | LR |
| Stromateidae | Peprilus triacanthus | Atlantic butterfish | Stromaté fossette | 701 | 159828 | 487 | LIn |
| Zoarcidae | Lycenchelys verrillii | Wolf eelpout | Lycode à tête longue | 603 | 159258 | 40 | LR |
| | Lycodes lavalaei | Newfoundland eelpout | Lycode du Labrador | 620 | 127107 | 72 | LR |
| | Lycodes reticulatus | Arctic eelpout | Lycode arctique | 641 | 127112 | 70 | LR |
| | Lycodes terraenovae | Newfoundland eelpout | Lycode du Labrador | 619 | 127117 | 64 | LR |
| | Lycodes vahlii | Vahl's eelpout | Lycode à carreaux | 647 | 127118 | 565 | LI |
| | Melanostigma atlanticum | Atlantic soft pout | Molasse atlantique | 646 | 127120 | 43 | LR |

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| Family | Scientific name | English name | French name | Species code | AphiaID | Num. records | Category |
|---|---|---|---|---|---|---|---|
| | Zoarces americanus | Ocean pout | Loquette d'Amérique | 640 | 159267 | 1,478 | LF |
| *Order: Pleuronectiformes* | | | | | | | |
| Cynoglossidae | Symphurus diomedeanus | Spottedfin tonguefish | Langue fil noir | 816 | 159358 | 24 | LR |
| Paralichthyidae | Citharichthys arctifrons | Gulf Stream flounder | Plie du Gulf Stream | 44 | 158791 | 382 | LIn |
| | Hippoglossina oblonga | Fourspot flounder | Cardeau à quatre ocelles | 142 | 158833 | 76 | LR |
| Pleuronectidae | Glyptocephalus cynoglossus | Witch flounder | Plie grise | 41 | 127136 | 4,301 | LF |
| | Hippoglossoides platessoides | American plaice | Plie canadienne | 40 | 127137 | 6,023 | LF |
| | Hippoglossus hippoglossus | Atlantic halibut | Flétan de l'Atlantique | 30 | 127138 | 1,634 | LF |
| | Limanda ferruginea | Yellowtail flounder | Limande à queue jaune | 42 | 158879 | 3,233 | LF |
| | Pseudopleuronectes americanus | Winter flounder | Limande-plie rouge | 43 | 158885 | 1,632 | LF |
| | Reinhardtius hippoglossoides | Greenland halibut | Flétan du Groënland | 31 | 127144 | 736 | LIn |
| Scophthalmidae | Scophthalmus aquosus | Windowpane flounder | Turbot de sable | 143 | 158907 | 115 | LR |
| *Order: Scorpaeniformes* | | | | | | | |
| | Aspidophoroides monopterygius | Alligatorfish | Poisson-alligator atlantique | 340 | 159459 | 1,029 | LIn |
| | Leptagonus decagonus | Atlantic poacher | Agone atlantique | 350 | 127191 | 266 | LIn |
| | Ulcina olrikii | Arctic alligatorfish | Poisson-alligator arctique | 341 | 274356 | 13 | LR |
| Cottidae | Artediellus atlanticus | Atlantic hookear sculpin | Hameçon atlantique | 880 | 127193 | 258 | LIn |
| | Artediellus uncinatus | Arctic hookear sculpin | Hameçon neigeux | 306 | 127195 | 306 | LIn |

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| Family | Scientific name | English name | French name | Species code | AphiaID | Num. records | Category |
|---|---|---|---|---|---|---|---|
| | Icelus spatula | Spatulate sculpin | Icèle spatulée | 314 | 127200 | 40 | LR |
| | Myoxocephalus aenaeus | Grubby | Chaboisseau bronzé | 303 | 159519 | 40 | LR |
| | Myoxocephalus octodecemspinosus | Longhorn sculpin | Chaboisseau à dix-huit épines | 300 | 159520 | 3,292 | LF |
| | Myoxocephalus scorpius | Shorthorn sculpin | Chaboisseau à épines courtes | 301 | 127203 | 131 | LR |
| | Triglops murrayi | Moustache sculpin | Faux-trigle armé | 304 | 127205 | 1,182 | LF |
| Cyclopteridae | Cyclopterus lumpus | Lumpfish | Lompe | 501 | 127214 | 216 | LI |
| | Eumicrotremus spinosus | Atlantic spiny lumpsucker | Petite poule de mer atlantique | 502 | 127217 | 226 | LIn |
| Hemitripteridae | Hemitripterus americanus | Sea raven | Hémitriptère atlantique | 320 | 159518 | 2,126 | LF |
| Liparidae | Careproctus reinhardti | Sea tadpole | Petite limace de mer | 520 | 127212 | 18 | LR |
| | Liparis atlanticus | Atlantic seasnail | Limace atlantique | 503 | 159524 | 34 | LR |
| | Liparis fabricii | Gelatinous snailfish | Limace gélatineuse | 505 | 127218 | 27 | LR |
| | Liparis gibbus | Variegated snailfish | Limace marbée | 512 | 159526 | 41 | LR |
| Psychrolutidae | Cottunculus microps | Polar sculpin | Cotte polaire | 307 | 127235 | 29 | LR |
| Sebastidae | Helicolenus dactylopterus | Blackbelly rosefish | Sébaste chèvre | 123 | 127251 | 610 | LIn |
| | Sebastes | Atlantic redfishes | Sébastes de l'Atlantique | 23 | 126175 | 4,152 | LF |
| *Order: Stomiiformes* | | | | | | | |
| Sternoptychidae | Maurolicus muelleri | Silvery lightfish | Brossé améthyste | 158 | 127312 | 52 | LR |
| | Sternoptychidae | Hatchetfishes | Haches d'argent | 741 | 125603 | 21 | LR |
| Stomiidae | Stomias boa | Boa dragonfish | Dragon-boa | 159 | 127374 | 20 | LR |
| *Order: Zeiformes* | | | | | | | |
| Zeidae | Zenopsis conchifer | Silvery John dory | Saint Pierre argenté | 704 | 127426 | 39 | LR |

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| Family | Scientific name | English name | French name | Species code | AphiaID | Num. records | Category |
|---|---|---|---|---|---|---|---|
| **Class: Elasmobranchii** | | | | | | | |
| *Order: Rajiformes* | | | | | | | |
| Rajidae | Amblyraja radiata | Thorny skate | Raie épineuse | 201 | 105865 | 3,937 | LF |
| | Dipturus laevis | Barndoor skate | Grande raie | 200 | 158548 | 246 | LI |
| | Leucoraja erinacea | Little skate | Raie hérisson | 203 | 158551 | 712 | LI |
| | Leucoraja ocellata | Winter skate | Raie tachetée | 204 | 158553 | 1,180 | LF |
| | Malacoraja senta | Smooth skate | Raie lisse | 202 | 158554 | 1,773 | LF |
| *Order: Squaliformes* | | | | | | | |
| Etmopteridae | Centroscyllium fabricii | Black dogfish | Aiguillat noir | 221 | 105906 | 31 | LR |
| Squalidae | Squalus acanthias | Picked dogfish | Aiguillat commun | 220 | 105923 | 1,985 | LF |
| **Class: Cephalopoda** | | | | | | | |
| *Order: Myopsida* | | | | | | | |
| Loliginidae | Doryteuthis pealeii | Longfin inshore squid | Calmar totam | 4512 | 574541 | 96 | LR |
| *Order: Oegopsida* | | | | | | | |
| Ommastrephidae | Illex illecebrosus | Northern shortfin squid | Encornet rouge nordique | 4511 | 153087 | 4,836 | LF |
| **Class: Malacostraca** | | | | | | | |
| *Order: Decapoda* | | | | | | | |
| Cancridae | Cancer borealis | Jonah crab | Crabe nordique | 2511 | 158056 | 1,387 | SF |
| | Cancer irroratus | Atlantic rock crab | Crabe commun | 2513 | 158057 | 788 | SF |
| Geryonidae | Chaceon quinquedens | Red deepsea crab | Crabe rouge | 2532 | 158407 | 33 | SR |
| Lithodidae | Lithodes maja | Atlantic king crab | Crabe épineux du nord | 2523 | 107205 | 531 | SF |
| Nephropidae | Homarus americanus | American lobster | Homard américain | 2550 | 156134 | 1,623 | SF |
| Oregoniidae | Chionoecetes opilio | Queen crab | Crabe des neiges | 2526 | 107315 | 1,546 | SF |
| | Hyas araneus | Great spider crab | Crabe lyre araignée | 2527 | 107322 | 625 | SF |

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| Family | Scientific name | English name | French name | Species code | AphiaID | Num. records | Category |
|---|---|---|---|---|---|---|---|
| | Hyas coarctatus | Arctic lyre crab | Crabe Hyas coarctatus | 2521 | 107323 | 711 | SF |
| Pandalidae | Pandalus borealis | Northern prawn | Crevette nordique | 2211 | 107649 | 718 | SF |

### 2.4 Analyses

The Oracle relational database where all survey data are stored and archived is accessible from the Bedford Institute of Oceanography in Dartmouth, Nova Scotia. Queries written in Structured Query Language (SQL) are used to extract the data from the production server and to create the data products used in all subsequent analyses. Catch records classified as ”valid” (i.e. coming from a representative tow without damage to the net, and coded as ”type=1” in the Oracle database) are used in the current analyses. To make the available samples comparable, catch weight for each species was standardized for the distance towed. The results of the different comparative fishing experiments (Koeller and Smith 1983; Fanning 1984; Fowler and Showell 2009) show the existence of differences in the fishing efficiency of fishing platforms for some species. However, correction factors were only computed for six species by Fanning (1984), and the correction factors derived from other comparative fishing experiments, and for other species, were never unequivocally agreed upon in peer-review meetings (Don S. Clark, pers. comm.). To provide a synoptic overview for all the species considered in this report, no further correction factors are used in the present analyses.

All data processing and analyses were conducted using the R software (R Core Team 2021) using packages gstat (Pebesma 2004), PBSmapping (Schnute et al. 2019), RODBC (Ripley and Lapsley 2019), spatstat (Baddeley 2015), maptools (Bivand and Lewin-Koh 2020), rgeos (Bivand and Rundel 2020), classInt (Bivand 2020), RColorBrewer (Neuwirth 2014), MASS (Ripley et al. 2020), worms (Holstein 2018), and tidyverse (Wickham 2019). The present document is rendered as a Technical Report using the csasdown R package (Anderson et al. 2021).

#### 2.4.1 Geographic distribution of catches

Spatial interpolation of catch (biomass/tow or abundance/tow) was done using a weighting inversely proportional to the distance (inverse-distance weighted, IDW), using function ”idw” of the spatstat R package (Baddeley 2015). To achieve a visually appropriate rendition of the available catch data, the IDW method uses a power parameter value of 10. The IDW predictions are over a fixed grid with a resolution of 200 by 200 on the bounding box of the georeferenced survey data.

#### 2.4.2 Abundance and biomass indices

For each species, stratified random estimates of catch biomass or abundance (Smith 1996) were computed for each year. Yearly estimates of the standard error were also computed. It must be noted that these are likely to be overestimates of the true stratified variance (Smith (1997)) and may lead to negative values for the lower confidence limits. In years where some strata were not sampled, the stratified estimate is calculated ignoring the missed strata. This implicitly assumes that the captures in the missed strata were the same as the overall mean. If a species does not follow this assumption in the missed strata the estimate will be biased. As such, the values presented herein should be treated with further analytical detail to ascertain that the estimate is unbiased.

### 2.4.3 Distribution indices

For each Category L and S species, the minimum area required to account for 75% and 95% of the total biomass were computed (D75% and D95%). For each category LIn species, the minimum area required to account for 75% and 95% of the total abundance were computed (D75% and D95%). These measures of distributions were computed for each year by using the Lorenz curve of mean stratum-level catch estimates and the area of occupied strata (Swain and Sinclair 1994; Swain and Morin 1996).

### 2.4.4 Length frequencies

The length frequency distribution of catch (the stratified numbers-at-length) is tabulated for each seven-year period (1970-2009), and last ten-year period (2010-2020). The stratified numbers-at-length is similar to the stratified random estimates of abundance (Smith 1996), but is calculated yearly for each length interval.

### 2.4.5 Length-weight relationship and condition factor

For Category LF species, individual records of fish length and weight are used to estimate the overall length-weight relationship of each species. The following non-linear allometric relationship is fitted to observations for each species:

$$W = \alpha L^{\beta}$$

where $W$ is the observed weight (g), L is the length (cm), and, $\alpha$ and $\beta$ are estimated parameters. The estimated parameters are used to compute a predicted weight based on an individual's length. The predicted weight and the observed weight are used to calculate each individual's relative fish condition (C) (as per Le Cren 1951):

$$C = \frac{W}{\alpha L^{\beta}}$$

Note that the fish condition for Atlantic herring (species code 60) is only calculated until 2015 since the survey protocol changed from fork length measurements in centimeters to total length measurements in millimeters in 2016 (Don S. Clark, pers. comm.).

### 2.4.6 Depth, temperature and salinity distribution of catches

For each category L species, we followed the methods developed by (Perry and Smith 1994) and generated cumulative frequency distributions of depth, temperature and salinity of survey catches. These cumulative frequency distributions can be compared to those obtained when using all survey sets in order to identify depth, temperature and salinity associations for the different species captured in the survey.

### 2.4.7 Density-dependent habitat selection

We followed the methods of (Myers and Stokes 1989) to evaluate how fish abundance in each stratum varied with overall temporal fluctuations of population abundance.

For each category L species, we fitted a model of the relationship between stratum-level density and overall abundance (the yearly stratified random estimate of abundance, defined above). To properly use the observations of zero catch while accounting for the logarithmic distribution of catch abundance, we implemented a generalized linear model using a log link and a Poisson error distribution:

$$Y_{h,i} = \alpha_h Y_i^{\beta_h}$$

where, $Y_{s,h,i}$ is the abundance in set $s$ of stratum $h$ in year $i$, and $\alpha_h$ and $\beta_h$ are the fitted parameters. The estimated parameter $\beta_h$ is referred to as the "slope parameter" and indicates whether stratum-level density is positively ($\beta_h <= 0$), negatively ($\beta_h >= 0$) or negligibly ($\beta_h \approx 0$) related to population abundance.

To estimate the suitability of each stratum, the median abundance observed during the years that are in the top 25% of yearly estimates is used. We combine the slope parameter estimates from the above model with the median abundance to identify strata that have consistently high abundance and whose local density is weakly related to fluctuation in population abundance ($\beta_h \approx 0$). Preferred strata are identified for each category L species.

## 2.5 Description of Figures

The figures generated for each species are presented in the Appendix and consist of up to six figures (Figure types A to F) per species, depending on their taxonomic level classification (as described in Section 2.3 above). The figure types are used as a suffix in each figure number.

### 2.5.1 Type A

For Category L species:

Spatial distribution of catch-per unit of effort, (CPUE, in kilograms per tow for LF and LI species, or in abundance per tow for LIn species) in July-August for the Bay of Fundy and Scotian Shelf for different time periods. The top-left map shows the first 10 years of available data (1970-1979). The other maps use data for 5-year (1980-1984, 1985-1989, 1990-1994, 1995-1999, 2000-2004, 2005-2009, 2010-2014) or 6-year (2015-2020) periods. Spatial interpolation between tows was done using Inverse Distance Weight (IDW). The probability of occurrence ($P(occ)$, the proportion of tows with catch records for a given species) was also reported for each five-year period.

For Category S species:

Spatial distribution of catch-per unit of effort, (CPUE, in kilograms per tow) in July-August for the Bay of Fundy and Scotian Shelf for different time periods. The maps use data for 4-year (1999-2002, 2003-2006, 2007-2010, 2011-2014, 2015-2018) or 2-year (2019-2020) periods. Spatial interpolation between tows was done using Inverse Distance Weight (IDW). The probability of occurrence ($P(occ)$, the proportion of tows with catch records for a given species) was also reported for each five-year period.

For Category LR and SR:

Location of tows with catch over the period 1970-2020 (Type LR) or the period 1999-2020 (Type SR).

### 2.5.2 Type B

For Category LF, LI and S species:

Stratified random estimate of CPUE (left panel), distribution indices (D75% and D95%, the minimum area containing 75% and 95% of biomass, middle panel), and distribution vs. weight per tow (right panel). The stratified random mean is plotted as a solid line with the 95% confidence region indicated by the solid grey line. The overall mean is plotted as a grey horizontal line and the overall mean plus or minus 50% of the standard deviation appear as horizontal dashed lines. Values of zero are used in cases where the lower limit is a negative value. In all three panels, the early years appear in blue and the last years appear in red. The predictions from a loess estimator are overlaid on the distribution indices (middle panel). The Pearson correlation coefficient between D75% and biomass, and its statistical significance, are also reported in the right panel.

For Category LIn species:

Stratified random estimate of CPUE (left panel), distribution indices (D75% and D95%, the minimum area containing 75% and 95% of abundance, middle panel), and distribution vs. abundance per tow (right panel). The stratified random mean is plotted as a solid line with the 95% confidence region indicated by the solid grey line. The overall mean is plotted as a grey horizontal line and the overall mean plus or minus 50% of the standard deviation appear as horizontal dashed lines. In all three panels, the early years appear in blue and the last years appear in red. The predictions from a loess estimator are overlaid on the distribution indices (middle panel). The Pearson correlation coefficient between D75% and biomass, and its statistical significance, are also reported in the right panel.

### 2.5.3 Type C.

For Category LF species:

Length frequency distribution for NAFO divisions 4X and 4VW. A smoothed length frequency distribution is shown for each 7-year periods for the period 1970 to 2009, and for the last last ten-year period (2010 to 2020).

### 2.5.4 Type D.

For Category LF species:

Yearly average fish condition for all fish lengths (black dots and black line), with the 25th and 75th percentiles appearing as gray polygons. Fish condition is presented separately for NAFO divisions 4VW (right panel) and 4X (left panel).

### 2.5.5 Type E.

For Category LF species:

Cumulative frequency distributions of depth, temperature and salinity at all sampled locations (thick solid line) and at fishing locations with catch records (thin dashed line). The depth, temperature and salinity associated with 5%, 25%, 50%, 75% and 95% of the cumulative catch is shown in tabular fashion on the bottom right panel.

### 2.5.6 Type F.

For Category LF species:

Slopes estimates from the density-dependent habitat selection model (y axis) plotted versus the median abundance during the top 25% of years. The red box and red labels indicate strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance. Each stratum is identified on the plot by the last two digits of its number.

# 3 Results

The figures generated for each species are presented in Section 6.

## 3.1 Summary of successful tows by year and stratum

A total of 9080 representative tows were conducted for the period spanning from 1970 to 2020 (Figure 4). Tables 5 to 10 present the number of tows conducted in each stratum and year.

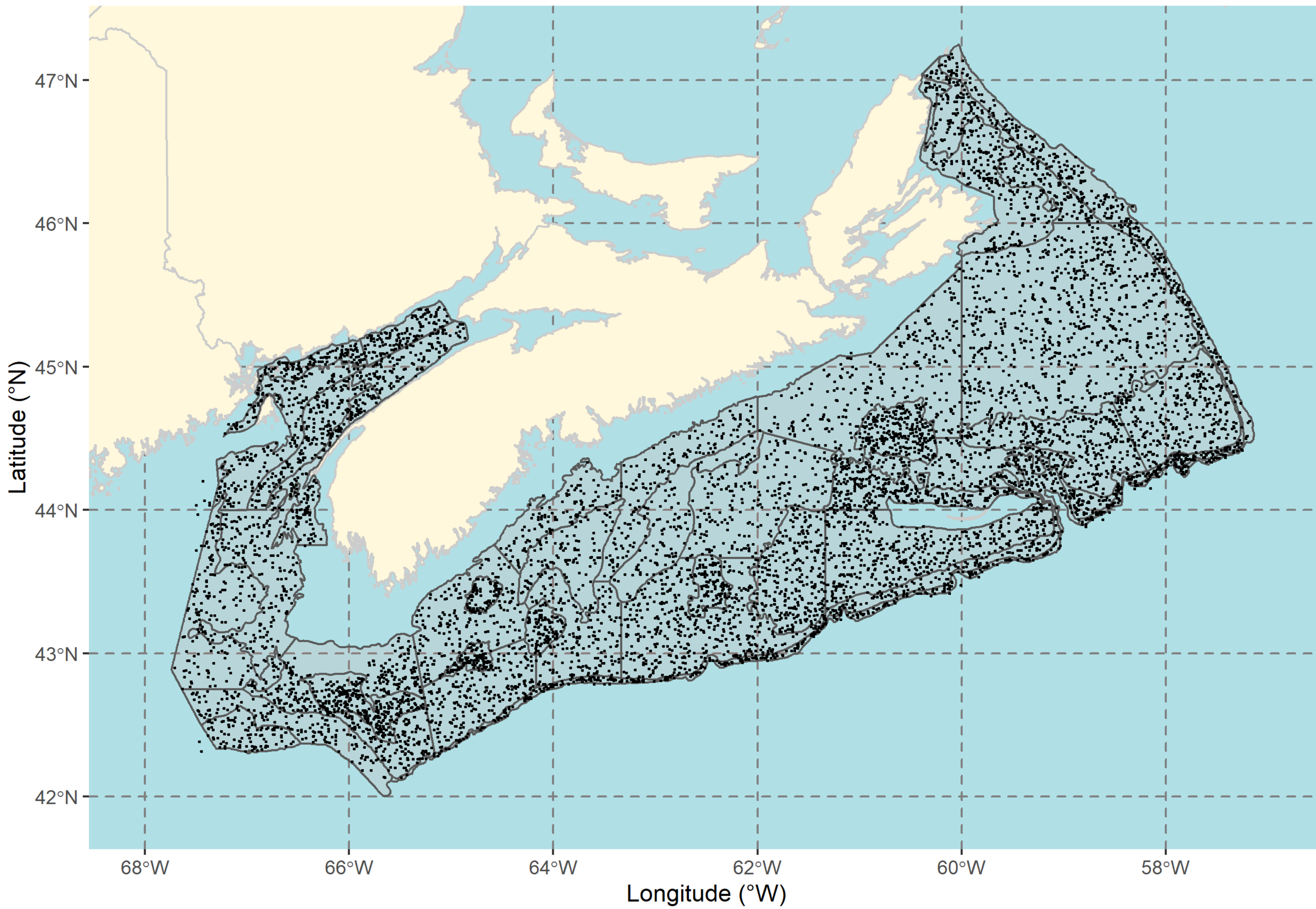



Figure 4. Map of the 9080 representative tows in the Summer survey from 1970 to 2020.

Table 5. Number of representative tows conducted in each stratum during the period 1970 to 1978.

| Stratum | NAFO Div. | Area (km2) | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 440 | 4VN | 3,173 | 4 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| 441 | 4VN | 3,434 | 4 | 2 | 2 | 3 | 3 | 3 | 1 | 3 | 3 |
| 442 | 4VN | 4,935 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 | 3 |
| 443 | 4VSW | 4,526 | 4 | 2 | 4 | 4 | 8 | 3 | 1 | 2 | 4 |
| 444 | 4VSW | 13,478 | 3 | 2 | 5 | 4 | 6 | 4 | 6 | 7 | 4 |
| 445 | 4VSW | 3,513 | 5 | 2 | 5 | 4 | 5 | 5 | 1 | 3 | 4 |
| 446 | 4VSW | 1,686 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 447 | 4VSW | 5,549 | 4 | 2 | 6 | 5 | 7 | 4 | 4 | 3 | 4 |
| 448 | 4VSW | 4,976 | 5 | 2 | 5 | 4 | 5 | 4 | 4 | 4 | 4 |
| 449 | 4VSW | 494 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 1 |
| 450 | 4VSW | 1,315 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| 451 | 4VSW | 505 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 452 | 4VSW | 1,185 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 453 | 4VSW | 889 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 454 | 4VSW | 1,714 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 455 | 4VSW | 7,287 | 7 | 6 | 7 | 6 | 7 | 6 | 6 | 7 | 7 |
| 456 | 4VSW | 3,279 | 5 | 4 | 6 | 5 | 5 | 6 | 4 | 6 | 6 |
| 457 | 4VSW | 2,785 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |
| 458 | 4VSW | 2,260 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 459 | 4VSW | 10,810 | 3 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 460 | 4VSW | 4,615 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 |
| 461 | 4VSW | 3,963 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 462 | 4VSW | 7,266 | 3 | 3 | 4 | 3 | 4 | 4 | 4 | 4 | 4 |
| 463 | 4VSW | 1,037 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 464 | 4VSW | 4,454 | 4 | 3 | 5 | 3 | 3 | 6 | 5 | 5 | 5 |
| 465 | 4VSW | 8,183 | 6 | 5 | 5 | 4 | 5 | 4 | 5 | 5 | 5 |
| 466 | 4VSW | 776 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| 470 | 4X | 3,159 | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |
| 471 | 4X | 3,448 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 472 | 4X | 4,289 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 473 | 4X | 910 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 474 | 4X | 553 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 475 | 4X | 536 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 476 | 4X | 5,075 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 |
| 477 | 4X | 4,231 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 478 | 4X | 800 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 2 |
| 480 | 4X | 2,249 | 4 | 4 | 4 | 3 | 3 | 3 | 4 | 4 | 3 |
| 481 | 4X | 6,439 | 5 | 3 | 4 | 4 | 4 | 3 | 4 | 4 | 5 |
| 482 | 4X | 3,578 | 2 | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 2 |
| 483 | 4X | 1,827 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 |
| 484 | 4X | 7,775 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| 485 | 4X | 5,433 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| 490 | 4X | 2,064 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |
| 491 | 4X | 2,359 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 492 | 4X | 3,729 | 3 | 2 | 4 | 3 | 3 | 3 | 3 | 3 | 3 |
| 493 | 4X | 1,830 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 494 | 4X | 1,432 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 495 | 4X | 2,005 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 |
| | **Total** | **171,810** | **134** | **110** | **146** | **134** | **153** | **143** | **135** | **144** | **141** |

Table 6. Number of representative tows conducted in each stratum during the period 1979 to 1987.

| Stratum | NAFO Div. | Area (km2) | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 440 | 4VN | 3,173 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 5 | 5 |
| 441 | 4VN | 3,434 | 3 | 3 | 3 | 3 | 3 | 3 | 5 | 5 | 4 |
| 442 | 4VN | 4,935 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 5 | 6 |
| 443 | 4VSW | 4,526 | 4 | 4 | 3 | 5 | 4 | 4 | 4 | 6 | 6 |
| 444 | 4VSW | 13,478 | 4 | 4 | 5 | 5 | 6 | 4 | 4 | 6 | 6 |
| 445 | 4VSW | 3,513 | 4 | 4 | 5 | 5 | 3 | 4 | 5 | 6 | 4 |
| 446 | 4VSW | 1,686 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 3 | 3 |
| 447 | 4VSW | 5,549 | 4 | 5 | 4 | 4 | 4 | 4 | 4 | 5 | 7 |
| 448 | 4VSW | 4,976 | 4 | 4 | 6 | 4 | 4 | 4 | 4 | 5 | 5 |
| 449 | 4VSW | 494 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 |
| 450 | 4VSW | 1,315 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 451 | 4VSW | 505 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 |
| 452 | 4VSW | 1,185 | 2 | 2 | 4 | 2 | 2 | 2 | 2 | 2 | 3 |
| 453 | 4VSW | 889 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| 454 | 4VSW | 1,714 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 |
| 455 | 4VSW | 7,287 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 8 | 8 |
| 456 | 4VSW | 3,279 | 6 | 6 | 7 | 6 | 6 | 6 | 6 | 6 | 7 |
| 457 | 4VSW | 2,785 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 4 |
| 458 | 4VSW | 2,260 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 5 | 5 |
| 459 | 4VSW | 10,810 | 4 | 4 | 4 | 3 | 4 | 4 | 6 | 6 | 5 |
| 460 | 4VSW | 4,615 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 3 |
| 461 | 4VSW | 3,963 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 |
| 462 | 4VSW | 7,266 | 4 | 6 | 4 | 4 | 4 | 4 | 4 | 6 | 5 |
| 463 | 4VSW | 1,037 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 |
| 464 | 4VSW | 4,454 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 7 | 6 |
| 465 | 4VSW | 8,183 | 5 | 5 | 7 | 6 | 5 | 5 | 5 | 5 | 8 |
| 466 | 4VSW | 776 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 |
| 470 | 4X | 3,159 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| 471 | 4X | 3,448 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 472 | 4X | 4,289 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 4 |
| 473 | 4X | 910 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 474 | 4X | 553 | 2 | 2 | 2 | 2 | 2 | 0 | 2 | 2 | 2 |
| 475 | 4X | 536 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 476 | 4X | 5,075 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 4 |
| 477 | 4X | 4,231 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 5 |
| 478 | 4X | 800 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| 480 | 4X | 2,249 | 4 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 |
| 481 | 4X | 6,439 | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 6 |
| 482 | 4X | 3,578 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| 483 | 4X | 1,827 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 484 | 4X | 7,775 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 4 |
| 485 | 4X | 5,433 | 3 | 2 | 3 | 4 | 3 | 3 | 3 | 3 | 6 |
| 490 | 4X | 2,064 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 |
| 491 | 4X | 2,359 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 |
| 492 | 4X | 3,729 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 |
| 493 | 4X | 1,830 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| 494 | 4X | 1,432 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 495 | 4X | 2,005 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
|  | **Total** | **171,810** | **147** | **145** | **150** | **150** | **146** | **143** | **152** | **171** | **188** |

Table 7. Number of representative tows conducted in each stratum during the period 1988 to 1996.

| Stratum | NAFO Div. | Area (km2) | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 440 | 4VN | 3,173 | 6 | 4 | 4 | 4 | 4 | 3 | 4 | 4 | 4 |
| 441 | 4VN | 3,434 | 4 | 4 | 6 | 5 | 5 | 5 | 5 | 5 | 5 |
| 442 | 4VN | 4,935 | 7 | 5 | 5 | 5 | 6 | 5 | 6 | 6 | 6 |
| 443 | 4VSW | 4,526 | 5 | 2 | 4 | 2 | 4 | 3 | 3 | 4 | 4 |
| 444 | 4VSW | 13,478 | 3 | 6 | 7 | 8 | 8 | 9 | 6 | 8 | 8 |
| 445 | 4VSW | 3,513 | 4 | 4 | 4 | 4 | 4 | 5 | 7 | 4 | 4 |
| 446 | 4VSW | 1,686 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| 447 | 4VSW | 5,549 | 6 | 6 | 8 | 7 | 7 | 7 | 7 | 7 | 6 |
| 448 | 4VSW | 4,976 | 5 | 5 | 9 | 6 | 6 | 7 | 7 | 7 | 6 |
| 449 | 4VSW | 494 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 450 | 4VSW | 1,315 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 451 | 4VSW | 505 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 4 |
| 452 | 4VSW | 1,185 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 |
| 453 | 4VSW | 889 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 |
| 454 | 4VSW | 1,714 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 3 |
| 455 | 4VSW | 7,287 | 7 | 7 | 12 | 10 | 10 | 9 | 10 | 10 | 10 |
| 456 | 4VSW | 3,279 | 6 | 6 | 10 | 7 | 7 | 8 | 8 | 8 | 8 |
| 457 | 4VSW | 2,785 | 2 | 2 | 4 | 2 | 2 | 2 | 2 | 2 | 2 |
| 458 | 4VSW | 2,260 | 3 | 3 | 9 | 8 | 8 | 8 | 8 | 8 | 7 |
| 459 | 4VSW | 10,810 | 6 | 5 | 5 | 5 | 6 | 4 | 6 | 6 | 4 |
| 460 | 4VSW | 4,615 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 461 | 4VSW | 3,963 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| 462 | 4VSW | 7,266 | 4 | 4 | 5 | 5 | 4 | 4 | 4 | 4 | 4 |
| 463 | 4VSW | 1,037 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 |
| 464 | 4VSW | 4,454 | 5 | 5 | 9 | 7 | 7 | 7 | 7 | 7 | 7 |
| 465 | 4VSW | 8,183 | 8 | 8 | 12 | 9 | 10 | 10 | 10 | 10 | 10 |
| 466 | 4VSW | 776 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 2 |
| 470 | 4X | 3,159 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 471 | 4X | 3,448 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 |
| 472 | 4X | 4,289 | 4 | 4 | 6 | 4 | 4 | 4 | 4 | 4 | 3 |
| 473 | 4X | 910 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 |
| 474 | 4X | 553 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 475 | 4X | 536 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 476 | 4X | 5,075 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 477 | 4X | 4,231 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 478 | 4X | 800 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 |
| 480 | 4X | 2,249 | 4 | 4 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| 481 | 4X | 6,439 | 7 | 6 | 8 | 9 | 9 | 9 | 9 | 7 | 9 |
| 482 | 4X | 3,578 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 483 | 4X | 1,827 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 484 | 4X | 7,775 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 485 | 4X | 5,433 | 7 | 6 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| 490 | 4X | 2,064 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 4 |
| 491 | 4X | 2,359 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 492 | 4X | 3,729 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| 493 | 4X | 1,830 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| 494 | 4X | 1,432 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 495 | 4X | 2,005 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | **Total** | **171,810** | **177** | **170** | **213** | **189** | **193** | **190** | **195** | **195** | **191** |

Table 8. Number of representative tows conducted in each stratum during the period 1997 to 2005.

| Stratum | NAFO Div. | Area (km2) | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 440 | 4VN | 3,173 | 4 | 4 | 4 | 6 | 4 | 4 | 4 | 4 | 4 |
| 441 | 4VN | 3,434 | 5 | 5 | 6 | 7 | 6 | 6 | 7 | 6 | 7 |
| 442 | 4VN | 4,935 | 6 | 6 | 7 | 6 | 6 | 5 | 6 | 6 | 7 |
| 443 | 4VSW | 4,526 | 5 | 5 | 4 | 5 | 4 | 5 | 5 | 5 | 4 |
| 444 | 4VSW | 13,478 | 7 | 8 | 8 | 9 | 10 | 9 | 9 | 9 | 8 |
| 445 | 4VSW | 3,513 | 4 | 3 | 3 | 6 | 5 | 5 | 5 | 5 | 6 |
| 446 | 4VSW | 1,686 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 447 | 4VSW | 5,549 | 7 | 7 | 6 | 7 | 7 | 7 | 7 | 7 | 7 |
| 448 | 4VSW | 4,976 | 7 | 6 | 7 | 8 | 8 | 8 | 8 | 7 | 8 |
| 449 | 4VSW | 494 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 450 | 4VSW | 1,315 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 451 | 4VSW | 505 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 452 | 4VSW | 1,185 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 |
| 453 | 4VSW | 889 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 454 | 4VSW | 1,714 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| 455 | 4VSW | 7,287 | 13 | 8 | 11 | 11 | 11 | 11 | 11 | 8 | 12 |
| 456 | 4VSW | 3,279 | 8 | 6 | 8 | 10 | 8 | 8 | 8 | 8 | 8 |
| 457 | 4VSW | 2,785 | 2 | 2 | 1 | 4 | 2 | 2 | 2 | 2 | 2 |
| 458 | 4VSW | 2,260 | 8 | 5 | 6 | 10 | 8 | 7 | 8 | 8 | 10 |
| 459 | 4VSW | 10,810 | 5 | 6 | 6 | 8 | 6 | 6 | 6 | 6 | 6 |
| 460 | 4VSW | 4,615 | 3 | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 4 |
| 461 | 4VSW | 3,963 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 4 |
| 462 | 4VSW | 7,266 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 |
| 463 | 4VSW | 1,037 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 4 |
| 464 | 4VSW | 4,454 | 4 | 7 | 7 | 7 | 7 | 7 | 7 | 5 | 8 |
| 465 | 4VSW | 8,183 | 10 | 9 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 466 | 4VSW | 776 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 470 | 4X | 3,159 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 471 | 4X | 3,448 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 472 | 4X | 4,289 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 473 | 4X | 910 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 |
| 474 | 4X | 553 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 475 | 4X | 536 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 |
| 476 | 4X | 5,075 | 4 | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 |
| 477 | 4X | 4,231 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 8 |
| 478 | 4X | 800 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| 480 | 4X | 2,249 | 8 | 8 | 8 | 7 | 8 | 8 | 8 | 7 | 9 |
| 481 | 4X | 6,439 | 9 | 9 | 9 | 8 | 9 | 8 | 9 | 6 | 12 |
| 482 | 4X | 3,578 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 4 |
| 483 | 4X | 1,827 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 484 | 4X | 7,775 | 3 | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 4 |
| 485 | 4X | 5,433 | 3 | 3 | 3 | 4 | 3 | 5 | 5 | 3 | 2 |
| 490 | 4X | 2,064 | 4 | 4 | 3 | 4 | 4 | 4 | 6 | 4 | 3 |
| 491 | 4X | 2,359 | 3 | 3 | 3 | 3 | 3 | 3 | 5 | 3 | 3 |
| 492 | 4X | 3,729 | 3 | 3 | 3 | 3 | 3 | 3 | 5 | 2 | 3 |
| 493 | 4X | 1,830 | 3 | 3 | 2 | 3 | 3 | 4 | 5 | 2 | 4 |
| 494 | 4X | 1,432 | 2 | 2 | 2 | 2 | 2 | 3 | 4 | 2 | 2 |
| 495 | 4X | 2,005 | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 2 | 2 |
| | **Total** | **171,810** | **193** | **186** | **191** | **213** | **201** | **208** | **216** | **188** | **222** |

Table 9. Number of representative tows conducted in each stratum during the period 2006 to 2014.

| Stratum | NAFO Div. | Area (km2) | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 440 | 4VN | 3,173 | 4 | 4 | 3 | 4 | 4 | 5 | 4 | 4 | 4 |
| 441 | 4VN | 3,434 | 6 | 6 | 5 | 6 | 6 | 7 | 6 | 6 | 6 |
| 442 | 4VN | 4,935 | 5 | 5 | 5 | 6 | 5 | 6 | 6 | 6 | 6 |
| 443 | 4VSW | 4,526 | 4 | 4 | 5 | 4 | 4 | 6 | 5 | 5 | 3 |
| 444 | 4VSW | 13,478 | 10 | 8 | 6 | 9 | 11 | 13 | 9 | 8 | 9 |
| 445 | 4VSW | 3,513 | 5 | 4 | 3 | 6 | 4 | 7 | 2 | 4 | 3 |
| 446 | 4VSW | 1,686 | 3 | 3 | 2 | 3 | 3 | 4 | 3 | 3 | 3 |
| 447 | 4VSW | 5,549 | 6 | 6 | 4 | 6 | 6 | 8 | 6 | 7 | 7 |
| 448 | 4VSW | 4,976 | 8 | 6 | 5 | 7 | 7 | 10 | 8 | 8 | 8 |
| 449 | 4VSW | 494 | 2 | 2 | 2 | 2 | 2 | 4 | 2 | 2 | 2 |
| 450 | 4VSW | 1,315 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 451 | 4VSW | 505 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 452 | 4VSW | 1,185 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 |
| 453 | 4VSW | 889 | 2 | 3 | 1 | 2 | 2 | 1 | 3 | 2 | 3 |
| 454 | 4VSW | 1,714 | 2 | 2 | 2 | 2 | 2 | 4 | 2 | 2 | 2 |
| 455 | 4VSW | 7,287 | 11 | 7 | 5 | 8 | 10 | 10 | 10 | 11 | 11 |
| 456 | 4VSW | 3,279 | 8 | 6 | 2 | 7 | 7 | 9 | 8 | 8 | 6 |
| 457 | 4VSW | 2,785 | 2 | 2 | 2 | 2 | 2 | 4 | 2 | 2 | 2 |
| 458 | 4VSW | 2,260 | 8 | 5 | 2 | 7 | 6 | 9 | 8 | 6 | 4 |
| 459 | 4VSW | 10,810 | 6 | 5 | 3 | 6 | 6 | 7 | 6 | 6 | 6 |
| 460 | 4VSW | 4,615 | 3 | 2 | 3 | 3 | 3 | 4 | 4 | 3 | 3 |
| 461 | 4VSW | 3,963 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 |
| 462 | 4VSW | 7,266 | 4 | 3 | 4 | 4 | 4 | 6 | 4 | 4 | 5 |
| 463 | 4VSW | 1,037 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 |
| 464 | 4VSW | 4,454 | 7 | 6 | 4 | 5 | 6 | 7 | 7 | 7 | 7 |
| 465 | 4VSW | 8,183 | 10 | 7 | 8 | 7 | 8 | 10 | 10 | 10 | 10 |
| 466 | 4VSW | 776 | 2 | 1 | 3 | 2 | 2 | 2 | 2 | 2 | 2 |
| 470 | 4X | 3,159 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 |
| 471 | 4X | 3,448 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 |
| 472 | 4X | 4,289 | 4 | 3 | 4 | 3 | 4 | 6 | 4 | 4 | 4 |
| 473 | 4X | 910 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 474 | 4X | 553 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 475 | 4X | 536 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 476 | 4X | 5,075 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 477 | 4X | 4,231 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 6 |
| 478 | 4X | 800 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 480 | 4X | 2,249 | 8 | 6 | 8 | 8 | 8 | 7 | 8 | 8 | 6 |
| 481 | 4X | 6,439 | 9 | 7 | 8 | 8 | 8 | 10 | 9 | 9 | 9 |
| 482 | 4X | 3,578 | 3 | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 3 |
| 483 | 4X | 1,827 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 |
| 484 | 4X | 7,775 | 4 | 3 | 3 | 4 | 3 | 5 | 5 | 5 | 4 |
| 485 | 4X | 5,433 | 5 | 4 | 5 | 5 | 5 | 6 | 5 | 5 | 5 |
| 490 | 4X | 2,064 | 3 | 3 | 4 | 3 | 3 | 4 | 2 | 4 | 3 |
| 491 | 4X | 2,359 | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 492 | 4X | 3,729 | 4 | 4 | 4 | 4 | 4 | 6 | 4 | 4 | 4 |
| 493 | 4X | 1,830 | 4 | 3 | 3 | 4 | 3 | 4 | 4 | 4 | 3 |
| 494 | 4X | 1,432 | 4 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 3 |
| 495 | 4X | 2,005 | 5 | 3 | 3 | 4 | 3 | 4 | 4 | 4 | 2 |
| | **Total** | **171,810** | **209** | **177** | **165** | **196** | **196** | **243** | **210** | **208** | **196** |

Table 10. Number of representative tows conducted in each stratum during the period 2015 to 2020 and for the whole 1970 to 2020 period.

| Stratum | NAFO Div. | Area (km2) | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Total |
|---|---|---|---|---|---|---|---|---|---|
| 440 | 4VN | 3,173 | 4 | 4 | 4 | 0 | 5 | 4 | 190 |
| 441 | 4VN | 3,434 | 6 | 6 | 6 | 0 | 7 | 4 | 238 |
| 442 | 4VN | 4,935 | 6 | 6 | 6 | 0 | 6 | 5 | 240 |
| 443 | 4VSW | 4,526 | 7 | 4 | 5 | 0 | 9 | 4 | 214 |
| 444 | 4VSW | 13,478 | 9 | 11 | 10 | 0 | 6 | 8 | 352 |
| 445 | 4VSW | 3,513 | 4 | 4 | 4 | 0 | 6 | 3 | 215 |
| 446 | 4VSW | 1,686 | 2 | 3 | 2 | 0 | 3 | 2 | 145 |
| 447 | 4VSW | 5,549 | 7 | 7 | 7 | 0 | 6 | 5 | 291 |
| 448 | 4VSW | 4,976 | 7 | 6 | 6 | 0 | 7 | 4 | 299 |
| 449 | 4VSW | 494 | 2 | 2 | 2 | 0 | 2 | 2 | 100 |
| 450 | 4VSW | 1,315 | 3 | 3 | 2 | 0 | 3 | 2 | 144 |
| 451 | 4VSW | 505 | 2 | 2 | 2 | 0 | 2 | 2 | 104 |
| 452 | 4VSW | 1,185 | 4 | 3 | 3 | 0 | 3 | 3 | 110 |
| 453 | 4VSW | 889 | 2 | 2 | 1 | 0 | 2 | 2 | 116 |
| 454 | 4VSW | 1,714 | 2 | 2 | 2 | 0 | 3 | 2 | 121 |
| 455 | 4VSW | 7,287 | 9 | 9 | 8 | 0 | 9 | 6 | 429 |
| 456 | 4VSW | 3,279 | 5 | 6 | 6 | 0 | 6 | 4 | 331 |
| 457 | 4VSW | 2,785 | 3 | 3 | 3 | 0 | 3 | 2 | 113 |
| 458 | 4VSW | 2,260 | 5 | 5 | 5 | 0 | 6 | 3 | 269 |
| 459 | 4VSW | 10,810 | 7 | 7 | 6 | 0 | 9 | 7 | 262 |
| 460 | 4VSW | 4,615 | 5 | 5 | 5 | 3 | 6 | 5 | 151 |
| 461 | 4VSW | 3,963 | 3 | 3 | 3 | 2 | 3 | 3 | 113 |
| 462 | 4VSW | 7,266 | 5 | 5 | 5 | 0 | 5 | 5 | 212 |
| 463 | 4VSW | 1,037 | 3 | 2 | 2 | 0 | 2 | 2 | 107 |
| 464 | 4VSW | 4,454 | 6 | 6 | 4 | 0 | 6 | 4 | 288 |
| 465 | 4VSW | 8,183 | 10 | 9 | 7 | 3 | 10 | 7 | 397 |
| 466 | 4VSW | 776 | 2 | 2 | 3 | 0 | 3 | 2 | 118 |
| 470 | 4X | 3,159 | 3 | 3 | 3 | 4 | 3 | 2 | 112 |
| 471 | 4X | 3,448 | 3 | 3 | 3 | 4 | 4 | 3 | 110 |
| 472 | 4X | 4,289 | 4 | 4 | 4 | 4 | 4 | 4 | 172 |
| 473 | 4X | 910 | 2 | 2 | 2 | 2 | 2 | 2 | 104 |
| 474 | 4X | 553 | 2 | 2 | 2 | 2 | 2 | 2 | 100 |
| 475 | 4X | 536 | 2 | 2 | 2 | 2 | 2 | 2 | 103 |
| 476 | 4X | 5,075 | 5 | 5 | 5 | 5 | 5 | 5 | 177 |
| 477 | 4X | 4,231 | 5 | 5 | 4 | 4 | 6 | 4 | 204 |
| 478 | 4X | 800 | 2 | 2 | 3 | 2 | 2 | 2 | 119 |
| 480 | 4X | 2,249 | 7 | 7 | 7 | 5 | 7 | 5 | 306 |
| 481 | 4X | 6,439 | 8 | 10 | 9 | 6 | 9 | 6 | 350 |
| 482 | 4X | 3,578 | 3 | 4 | 4 | 3 | 4 | 3 | 141 |
| 483 | 4X | 1,827 | 2 | 3 | 3 | 2 | 3 | 2 | 105 |
| 484 | 4X | 7,775 | 6 | 5 | 7 | 7 | 7 | 7 | 186 |
| 485 | 4X | 5,433 | 6 | 6 | 6 | 4 | 6 | 5 | 196 |
| 490 | 4X | 2,064 | 4 | 4 | 4 | 3 | 4 | 3 | 173 |
| 491 | 4X | 2,359 | 4 | 4 | 4 | 3 | 4 | 3 | 168 |
| 492 | 4X | 3,729 | 3 | 4 | 4 | 3 | 4 | 4 | 171 |
| 493 | 4X | 1,830 | 3 | 4 | 6 | 3 | 3 | 3 | 159 |
| 494 | 4X | 1,432 | 4 | 4 | 3 | 2 | 4 | 3 | 128 |
| 495 | 4X | 2,005 | 4 | 4 | 4 | 3 | 4 | 3 | 127 |
| | **Total** | **171,810** | **212** | **214** | **208** | **81** | **227** | **175** | **9,080** |

### 3.2 Distribution of depth, bottom temperature and bottom salinity from survey tows

The depth, bottom temperature, and bottom salinity cumulative frequency distribution for the survey are presented in Figure 5.

#### 3.2.1 Decadal distribution of surface and bottom temperatures

The decadal cumulative frequency distribution of surface and bottom temperatures of representative sets from the DFO Maritimes summer survey showcase warmer values of both surface and bottom temperature in the last decade (Figure 6).

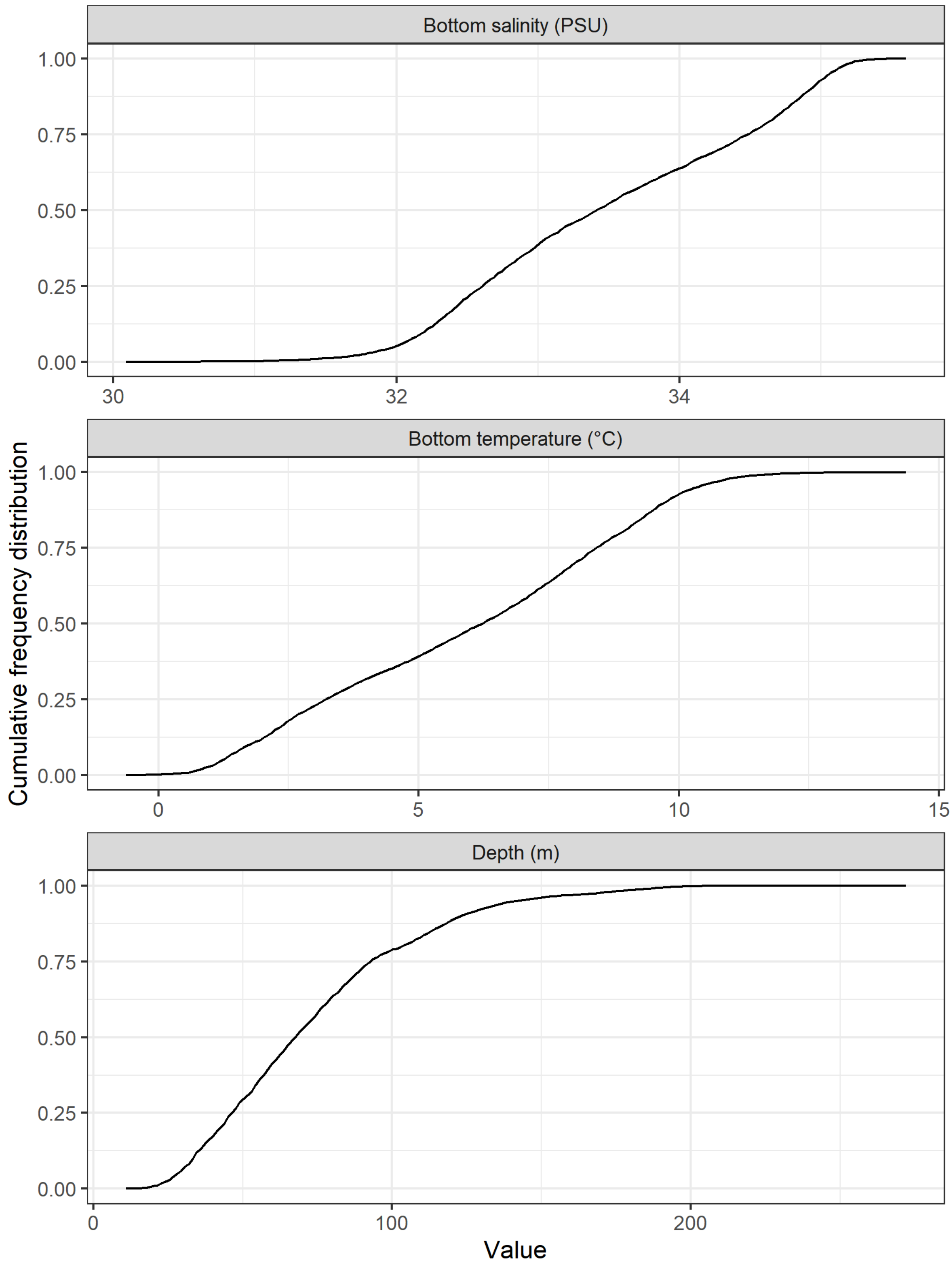



Figure 5. Cumulative frequency distribution of bottom salinity (top panel), bottom temperature (middle panel) and depth (bottom panel) of representative sets from the DFO Maritimes summer survey.

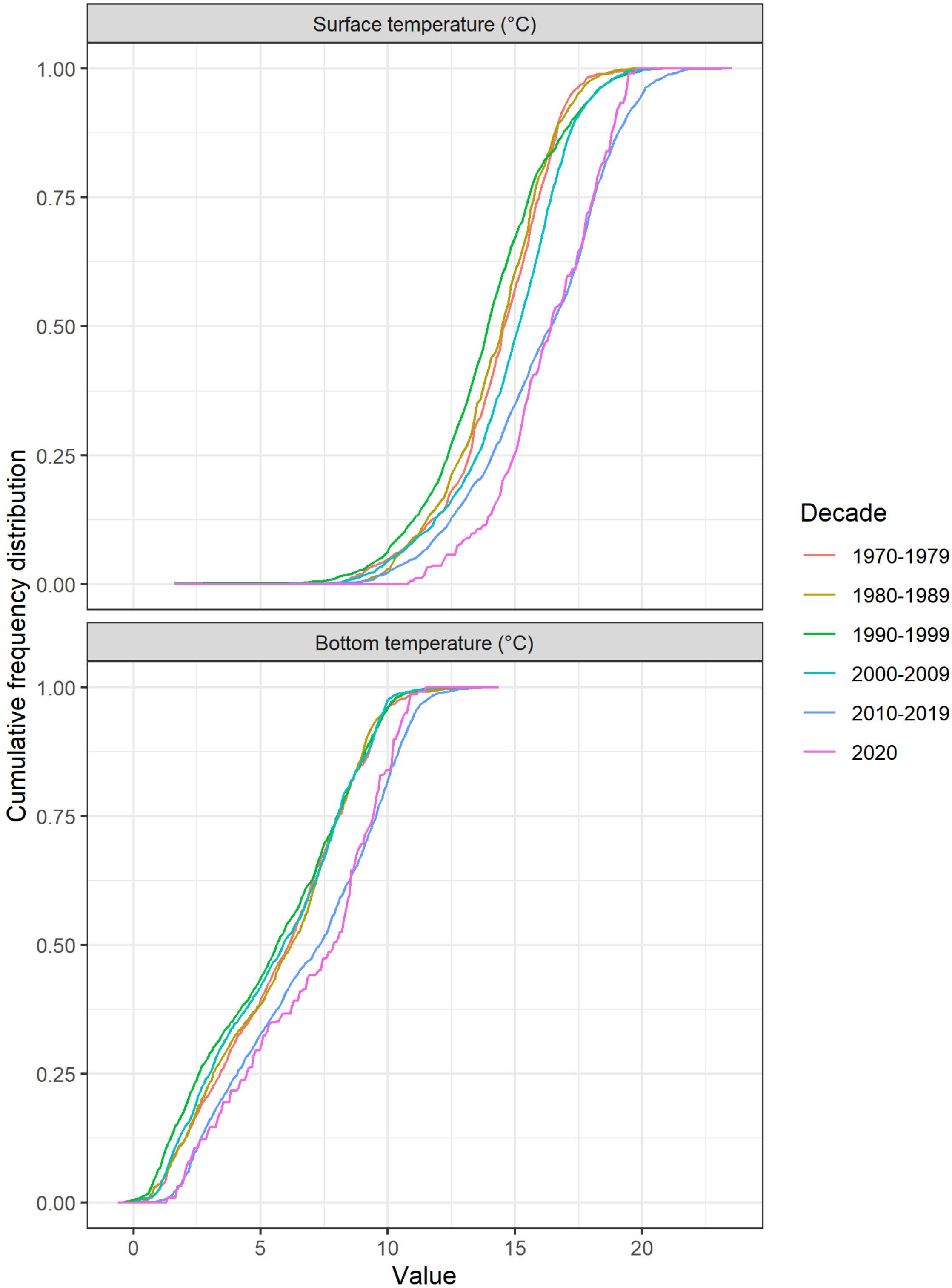



Figure 6. Decadal cumulative frequency distribution of surface temperature (top panel) and bottom temperature (bottom panel) of representative sets from the DFO Maritimes summer survey. Note warmer values of both surface and bottom temperature in the last decade.

# 4 Discussion

This report builds on previous work and former atlases by updating a comprehensive suite of indices to give a snapshot of population status and environmental associations of 103 fish and invertebrate species. The current document is not meant to replace stock assessments, species-specific analyses of abundance, biomass and distribution, or any targeted attempts to integrate information about species or group of species from the wide and disparate sources of data about marine organisms in the area covered by the DFO Maritimes summer trawl survey. It is rather meant to provide a reproducible set of tools to extract and visualize the information collected in the summer groundfish research vessel survey. It is hoped that this document can provide a stepping stone to conduct other ecological analyses using the trawl survey data and increase reproducibility and transparency of ecological information collected annually.

## 4.1 Diversity of approaches used for mapping fish and invertebrates in the Scotian Shelf bioregion

Different methods have been applied in the Northwest Atlantic, and specifically on the Scotian Shelf bioregion, to map fish and invertebrate species distribution. The present report, for example, builds upon the atlas of important habitat developed to map the persistence of relatively high biomass for key fish species using the summer groundfish research vessel survey (Horsman and Shackell 2009). Important habitat was obtained by interpolating observed weight by species using inverse-distance weighting (IDW), and calculating areas with relatively persistent high biomass for periods representing different fishery management eras. To complement information from this atlas, including additional representations of biomass and diversity, a similar IDW interpolation mapping procedure was followed by Smith et al. (2015), Ward-Paige and Bundy (2015), and Bundy et al. (2017). The summer groundfish research vessel survey is typically conducted during the month of July. However, from the fall of 1978 through to the spring of 1985, DFO also conducted spring and fall surveys using the same sampling design. This unique seasonal data was used to map the seasonal spatial distribution of key demersal and other fish species using IDW interpolation on the Scotian Shelf from the spring, summer and fall between 1978 and 1985 (Smith et al. 2015). Following recommendations provided by Kenchington and Kenchington (2017), the spatial distribution of three indicators of biodiversity for fish and invertebrates were mapped using IDW interpolation to identify areas with persistently high values across fishery management eras, and compared with areas of persistently high abundance for selected species (Ward-Paige and Bundy 2015). This analysis revealed a lack of consistent relationships between areas of persistent high diversity and persistent high biomass, suggesting that both can be used as independent and important spatial indicators of the system (Ward-Paige and Bundy 2015). Groupings of fishes and invertebrates based on size, habitat and feeding guild, were also mapped using IDW interpolations to identify hotspots of functional group diversity (Bundy et al. 2017). This analysis revealed a spatially and temporally variable distribution of functional diversity across the Scotian Shelf with notable areas of high and low diversity (Bundy et al. 2017). Top quintiles of each functional group using the IDW approach were used as representative layers for fish and invertebrates in the MPA Network design in the Scotian Shelf Bioregion (Serdynska et al. 2021). IDW interpolation methods have also been used to map the distribution of individual species such as sea cucumbers (*Cucumaria frondosa*) in the Scotian Shelf bioregion (Shackell et al. 2013), and sea scallop (*Placopecten magellanicus*) in Georges and Browns Bank (Hubley et al. 2014).

Species Distribution Modelling (SDM), instead of IDW, can also be used to evaluate spatio-temporal dynamics by predicting and understanding past, present and future distribution of species using environmental predictors (Robinson et al. 2017). A variety of modelling approaches are being implemented in Maritimes Region to map and predict fish and invertebrate species distribution by incorporating environmental predictors to account for seasonal and temporal variability. For example, a stock assessment of snow crab (*Chionoecetes opilio*) on the Scotian Shelf used data from the snow crab survey from 2005 to 2018 to map spatial data products for this stock, including annual predicted interpolations of potential habitat using Generalized Additive Models (GAM) and several environmental covariates including depth, curvature, slope, species composition, and annual temperature (Zisserson et al. 2019). Sea scallop predicted habitat using Maximum Entropy (MaxEnt) models were computed for German Bank using data compiled via benthic habitat mapping and seafloor geotechnical surveys in 2006, 2009, and 2010 (Brown et al. 2012). Predictions in the Scotian Shelf bioregion and the Northeast United States using datasets from DFO and the National Oceanic and Atmospheric Administration from 1993 to 2012 also predicted sea scallop habitat at a wider scale based on three scenarios of seasonal temperature and salinity climatologies (NOAA) (Lowen et al. 2019). Offshore American lobster stock assessments (*Homarus americanus*) used data from the RV, DFO Georges Bank, and National Marine Fisheries Service (NMFS) Northeast Fisheries Science Center (NEFSC) bottom trawl surveys (1970 to 2015) to predict species distribution using boosted regression trees and several environmental predictors (bathymetry, slope, curvature, and annual temperature interpolations) (Cook et al. 2017). Information on the potential for recovery of cusk (*Brosme brosme*) used data from the bottom longline Halibut industry survey and Cusk absences in the Summer groundfish research vessel survey from 1998-2013 to predict suitable habitat using GAM, MaxEnt, and random forest models and several physical environmental variables (e.g. complexity, benthic current stress and complexity, temperature, salinity, primary production, chlorophyll, suspended matter) (Harris et al. 2018). Atlantic halibut (*Hippoglossus hippoglossus*) assessments using Summer groundfish research vessel survey and NOAA survey data from 2001 to 2013 predicted juvenile habitat using MaxEnt model and environmental predictors (bathymetry, slope, bottom temperature) (French et al. 2018). Persistent areas of high Atlantic halibut juvenile abundance were predicted using data from 27 bottom trawl surveys combined (NMFS and DFO) from 1978 to 2013 and applying Bayesian hierarchical spatiotemporal models with two environmental predictors (depth and temperature) (Boudreau et al. 2017).

These examples of mapping efforts in Maritimes Region showcase the diversity of approaches relevant to a variety of important research questions and management applications. Approaches, methods, datasets, and environmental predictors are selected based on individual project research questions, and considerations for each species, communities or stock. This allows research groups to maintain innovation and keep up with emerging methods and technologies to improve assessments, predictions, and ultimately, science advice. The diversity of approaches also leads to complexity when looking across studies as each data compilation and predictive method carries its own independent assumptions and can lead to different spatial outputs. This presents challenges for developing consistent spatial products for marine spatial planning.

## 4.2 Interpreting spatial results for marine spatial planning purposes

Fisheries and Oceans Canada is leading a marine spatial planning process that brings together relevant authorities and stakeholders to better coordinate how we use and manage marine spaces to achieve ecological, economic and social objectives. Operationalizing marine spatial planning includes a series of steps, including the process of analyzing existing conditions by collecting and mapping information about ecological, environmental and oceanographic conditions (Ehler and Douvere 2009; Agardy et al. 2011). Mapping the distribution of species is critical for the implementation of spatial management and as a first step in marine spatial planning processes. Species distribution have supported the identification of important sites for a given species or areas of high richness and diversity, which in turn can be used to inform siting decisions of new activities such as Marine Protected Areas (MPA), aquaculture sites or wind turbines. In the Scotian Shelf bioregion, mapping species distributions has been used to highlight areas of high biological diversity to support the identification of Ecologically or Biologically Significant Areas (Ricard and Shackell 2013; Ward-Paige and Bundy 2015), to distinguish important and persistent habitat of significant species and functional groups to support MPA and conservation planning (Horsman and Shackell 2009; Smith et al. 2015; Ward-Paige and Bundy 2015; Bundy et al. 2017), to identify important habitat for Species at Risk (Harris et al. 2018) and to highlight reserves for data-poor invertebrate fisheries (Shackell et al. 2013). Mapping species distribution has also been used to illustrate multi-decadal scale projections of changes in species distribution in the context of climate change and adaption (Stanley et al. 2018; Greenan et al. 2019).

In support of the marine spatial planning process, a public web-based atlas with relevant geospatial information is being developed to support decision-making. This Atlantic Canada-wide compilation of data and information will be a web-based, public platform with interactive maps of ocean ecosystems, human uses and management areas. The current document cannot present the full diversity of data and mapping products that can be produced for the Maritimes Region. Consequently, we recommend that the data and mapping products presented in this report not be used blindly for the planned atlas, until an evaluation of what spatial information is available and what was used in the past is conducted.

This diverse portfolio of approaches and applications is not unique to the Maritimes Region. A recent review of global distribution modelling efforts recommended the adoption of a consistent framework that integrates multi-model approaches and a clear expression of errors and uncertainties (Robinson et al. 2017). In this context, Pacific Region has developed two initiatives to enable consistency and frequent publication, reproducibility, and transparency. One initiative developed a reproducible report to give a synthesis of data availability, population trends, fishing trends, growth and maturity patterns for 113 groundfish species in British Columbia to support stock assessment (Anderson et al. 2019, 2020). The second initiative developed a SDM framework that was applied to twelve species on Canada's Pacific coast as part of the Regional Response Plan (Nephin et al. 2019). The Maritimes region, through this and past reports, are also using similar reproducible approaches to facilitate annual updates and transparency (Ricard and Shackell 2013).

Recognizing the diversity of approaches for mapping fish and invertebrates in the Scotian Shelf bioregion, we recommend the development of a regional community of practice to compare and evaluate approaches for mapping, interpolating and/or modelling fish and invertebrates so future publications and advice related to spatial outputs can lead to more comparable work and consistent science advice to support processes such as marine spatial planning. At the international level, guidelines and standards related to appropriate variables and methods for mapping and modeling species and communities of deep-sea habitats were proposed to encourage the production of publications that will lead to more comparable work (Kenchington et al. 2019). Similar general guidance for how groups approach mapping activities would be a worthwhile product in the Maritimes Region. Until then, we propose the use of the Open Data record for the Maritimes RV surveys (DFO 2021) as a precursor to the public web-based marine spatial planning atlas.

## 5 Acknowledgements

We thank all the dedicated personnel involved in running trawl surveys in the Maritimes Region and the numerous colleagues in Maritimes Region that have shared information and advice in support of this report. The assistance of the Gulf Region secondary publications coordinator, Jeff Clements, in getting this report published is well appreciated. The document greatly benefited from the constructive comments of Adam Cook, Mariano Koen-Alonso and an anonymous reviewer.

## 6 Figures for all species analysed

The figures generated for each species are presented here and consist of up to six figures (Figure types A to F) per species, depending on their taxonomic level classification (as described in Section 2.3). The figure types are used as a suffix in each figure number.

To facilitate navigation, use the PDF navigation panel. Alternatively, Table 4 contains the list of all species presented and includes a hyperlink to the first page of figures for each species. Finally an Index is included at the end of the document, containing hyperlinks to each species based on its scientific name, English common name or French common name.

### 6.1 Atlantic cod (Morue franche) - species code 10 (category LF)

Scientific name: Gadus morhua

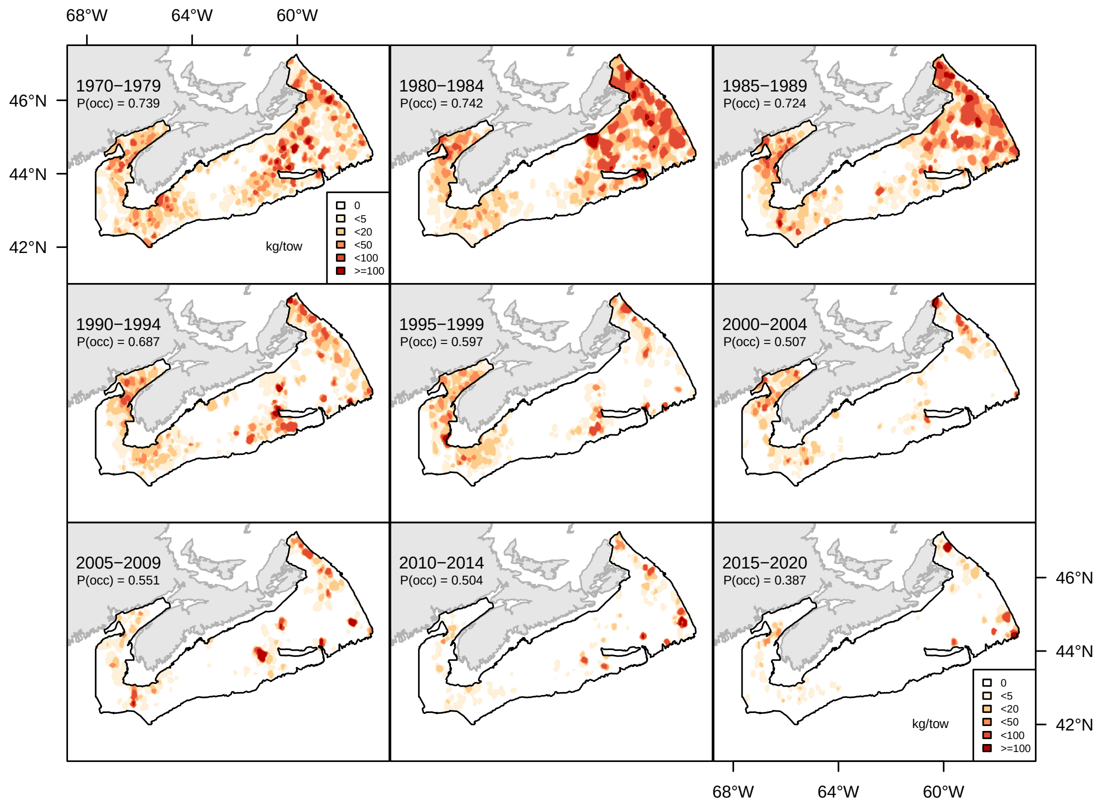



Figure 6.1A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic cod. $P(occ)$ is the proportion of tows with catch records for each 5-year period.

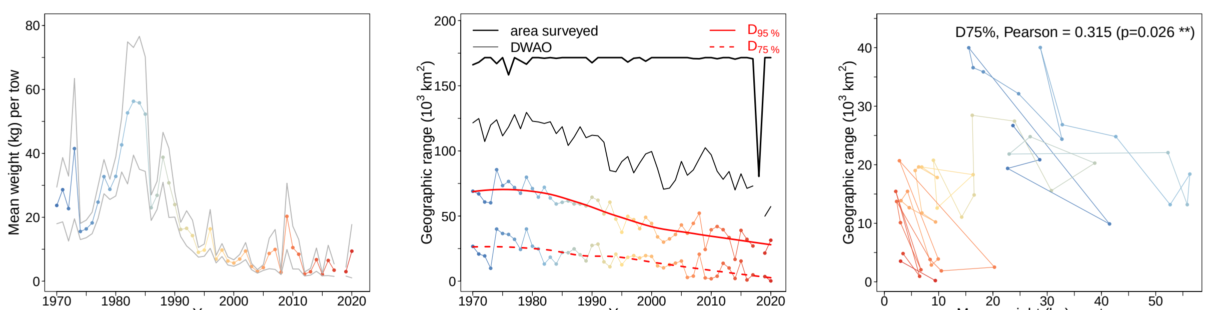



Figure 6.1B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic cod. The predictions from a loess estimator are overlaid on the distribution indices in the middle panel.

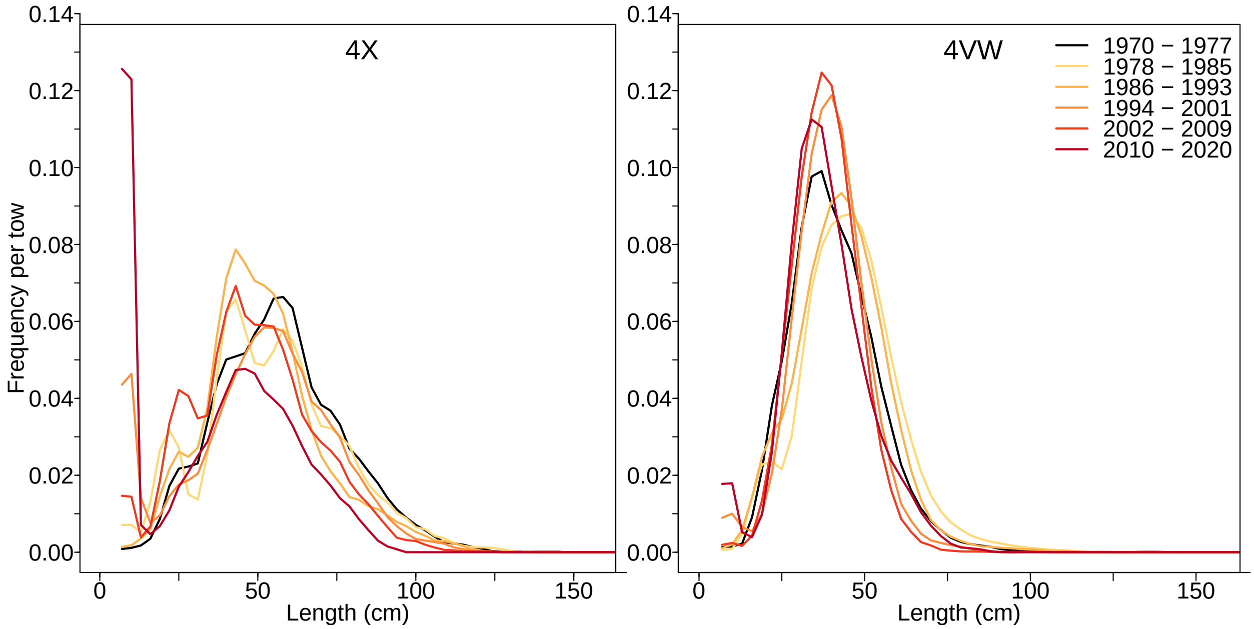



Figure 6.1C. Length frequency distribution in NAFO units 4X and 4VW for Atlantic cod.

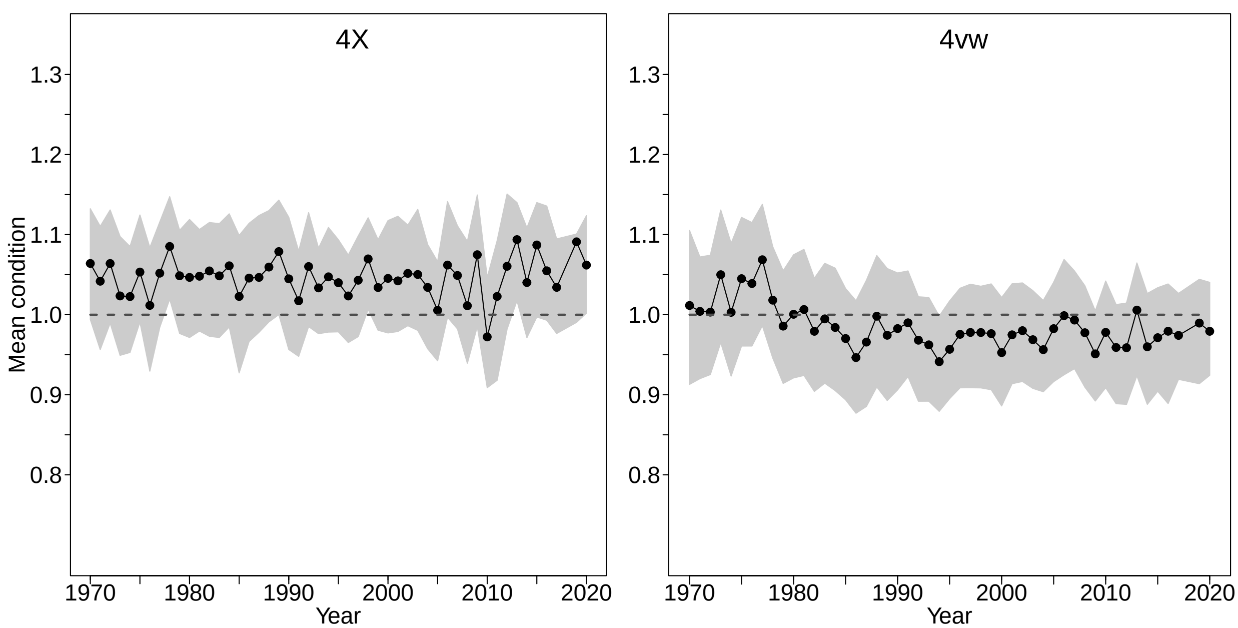
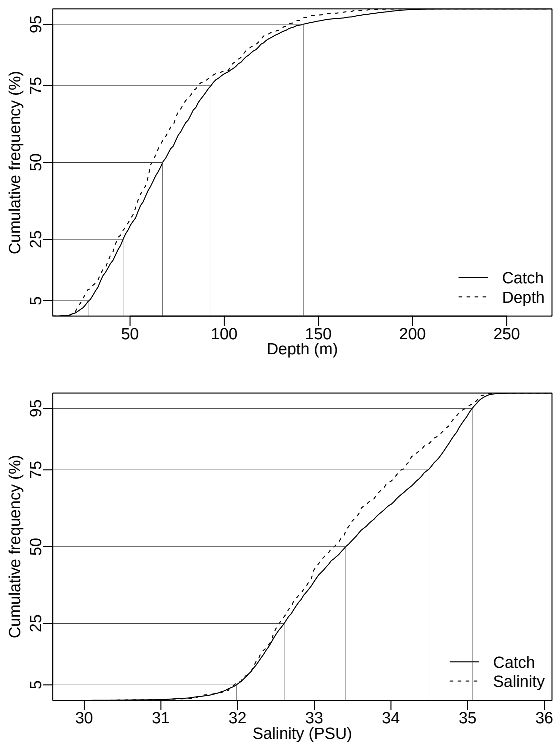



Figure 6.1D. Average fish condition in NAFO units 4X and 4VW for Atlantic cod.




| Frequency | Depth | Temperature | Salinity |
|---:|---:|---:|---:|
| 0.05 | 24 | 1.3 | 31.95 |
| 0.25 | 42 | 3.4 | 32.53 |
| 0.50 | 61 | 5.7 | 33.25 |
| 0.75 | 85 | 7.7 | 34.10 |
| 0.95 | 133 | 9.6 | 34.96 |

Figure 6.1E. Catch distribution by depth, temperature and salinity of Atlantic cod.

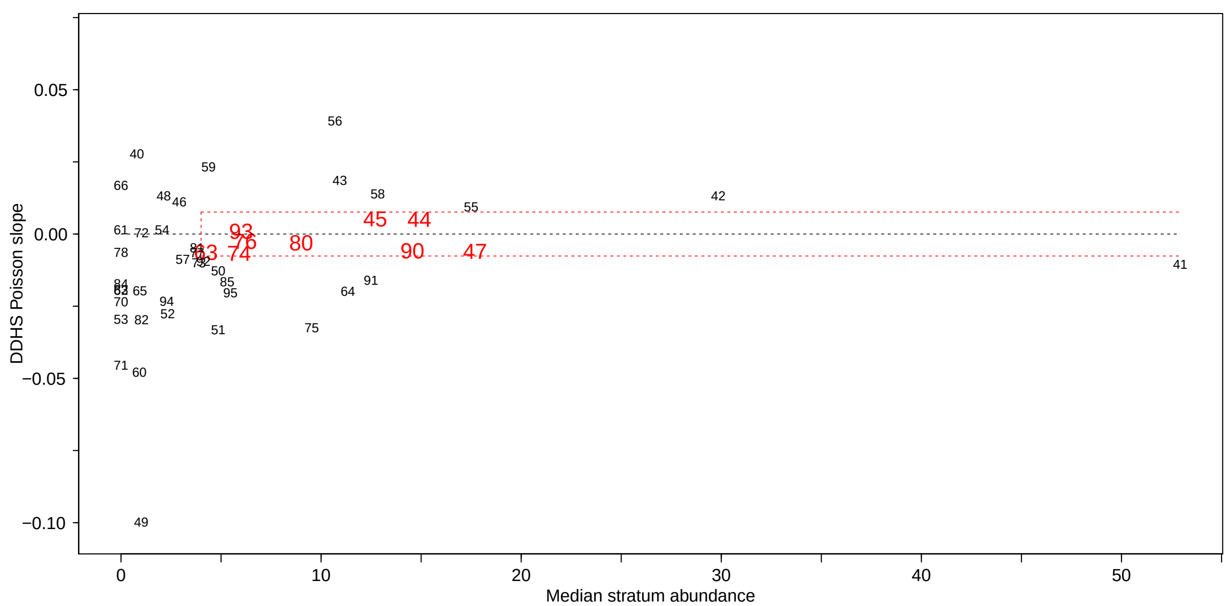



Figure 6.1F. DDHS slopes versus median stratum abundance for Atlantic cod. The last two digits of each stratum number is shown in the figure. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance.

## 6.2 Haddock (Aiglefin) - species code 11 (category LF)

Scientific name: [Melanogrammus aeglefinus]

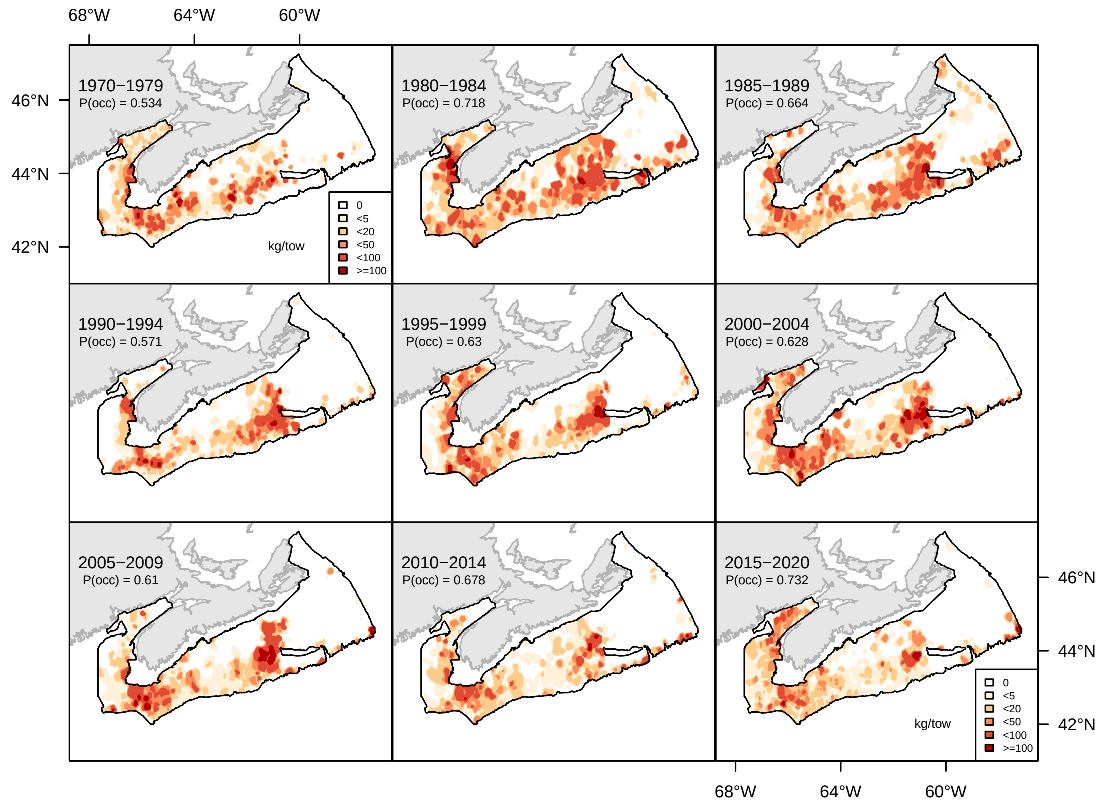



Figure 6.2A. Inverse distance weighted distribution of catch biomass (kg/tow) for Haddock. $P(occ)$ is the proportion of tows with catch records for each 5-year period.

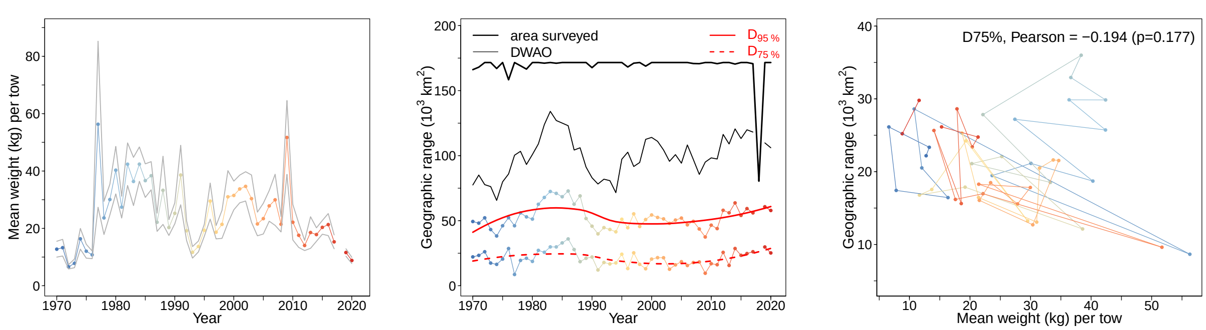



Figure 6.2B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Haddock. The predictions from a loess estimator are overlaid on the distribution indices in the middle panel.

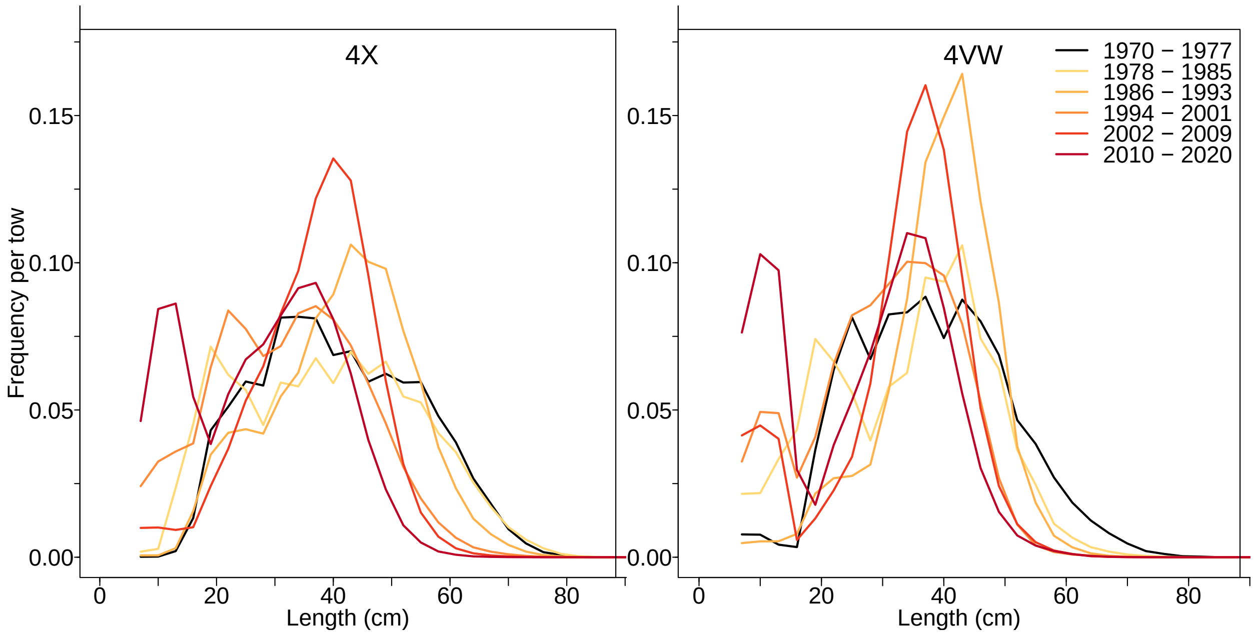



Figure 6.2C. Length frequency distribution in NAFO units 4X and 4VW for Haddock.

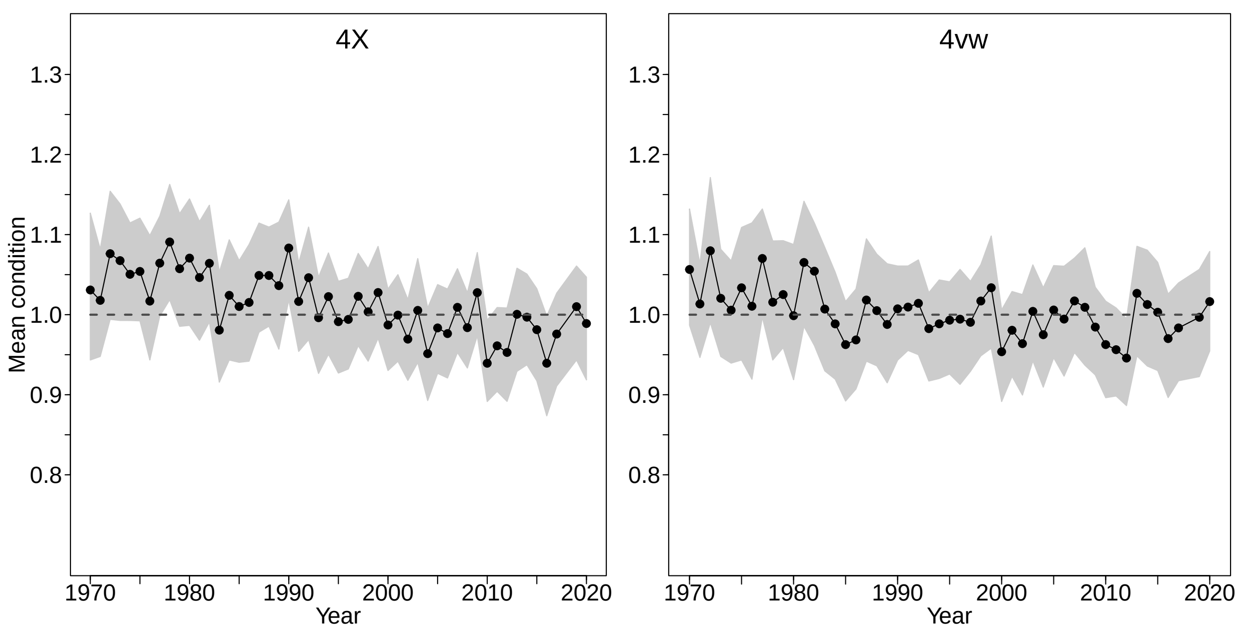
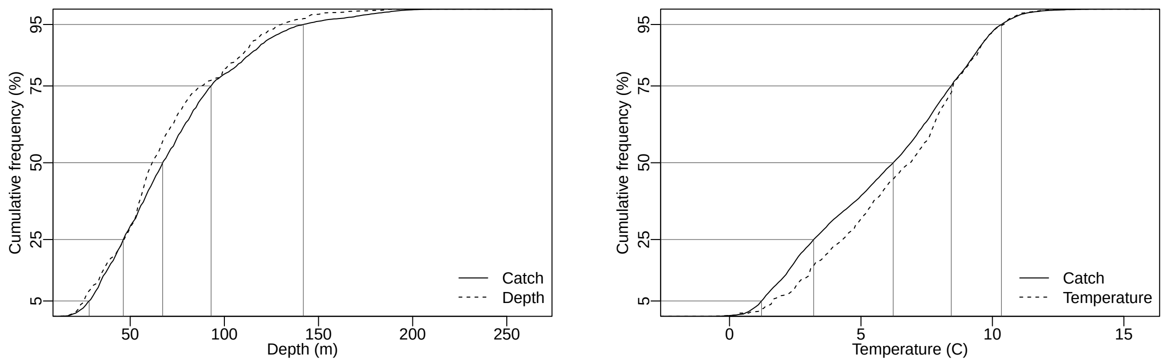
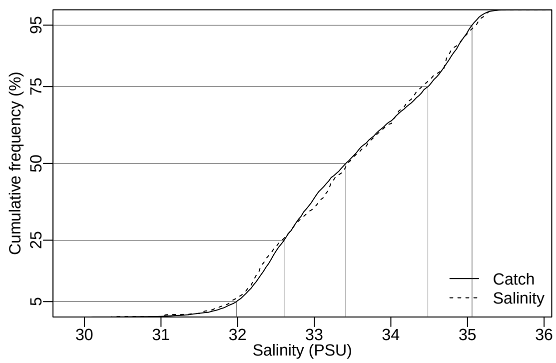



Figure 6.2D. Average fish condition in NAFO units 4X and 4VW for Haddock.




| Frequency | Depth | Temperature | Salinity |
|---|---|---|---|
| 0.05 | 25 | 1.6 | 31.88 |
| 0.25 | 46 | 4.2 | 32.57 |
| 0.50 | 61 | 6.8 | 33.42 |
| 0.75 | 88 | 8.4 | 34.40 |
| 0.95 | 130 | 10.4 | 35.09 |

Figure 6.2E. Catch distribution by depth, temperature and salinity of Haddock.

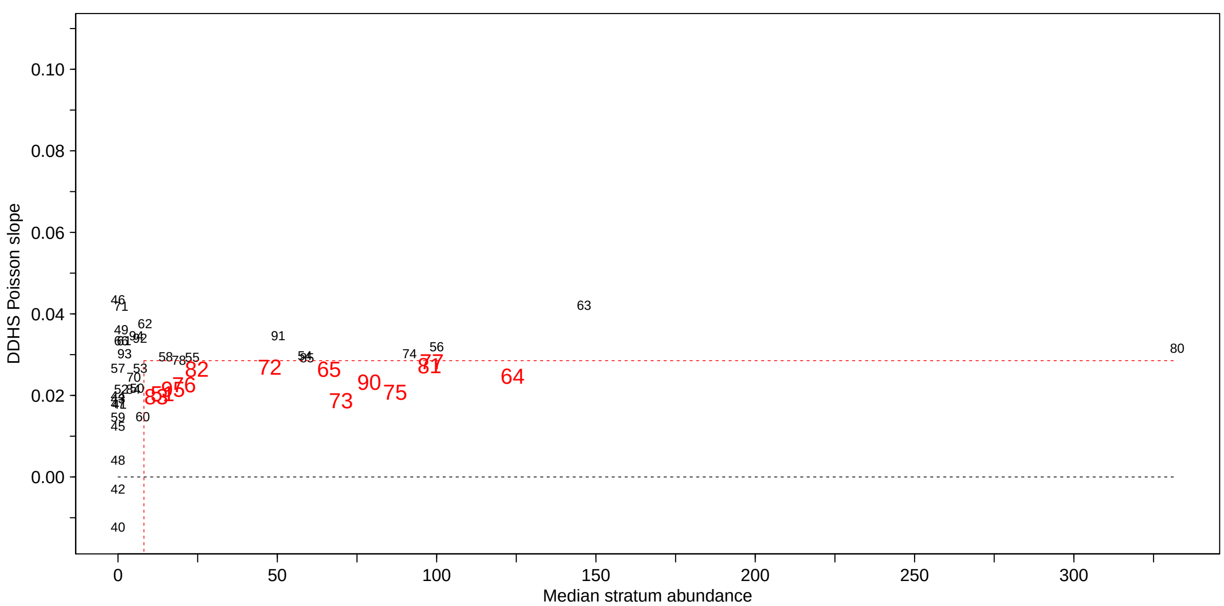



Figure 6.2F. DDHS slopes versus median stratum abundance for Haddock. The last two digits of each stratum number is shown in the figure. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance.

## 6.3 White hake (Merluche blanche) - species code 12 (category LF)

Scientific name: [Urophycis tenuis]

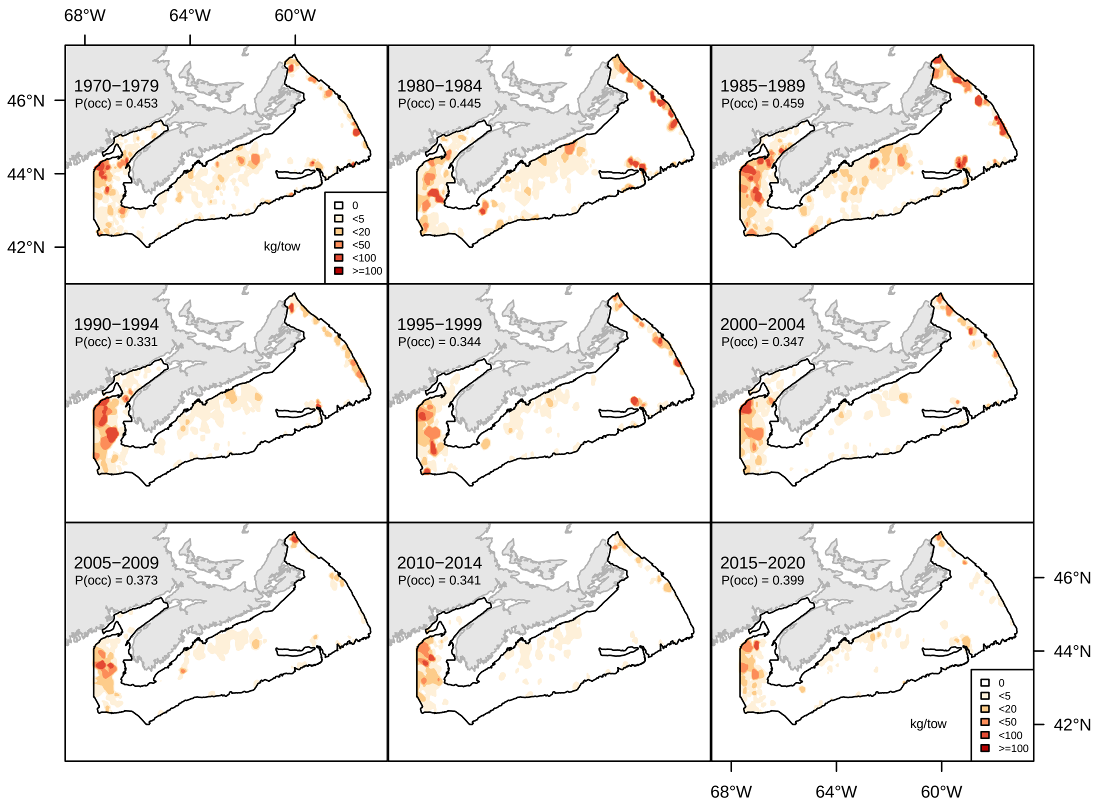



Figure 6.3A. Inverse distance weighted distribution of catch biomass (kg/tow) for White hake. $P(occ)$ is the proportion of tows with catch records for each 5-year period.

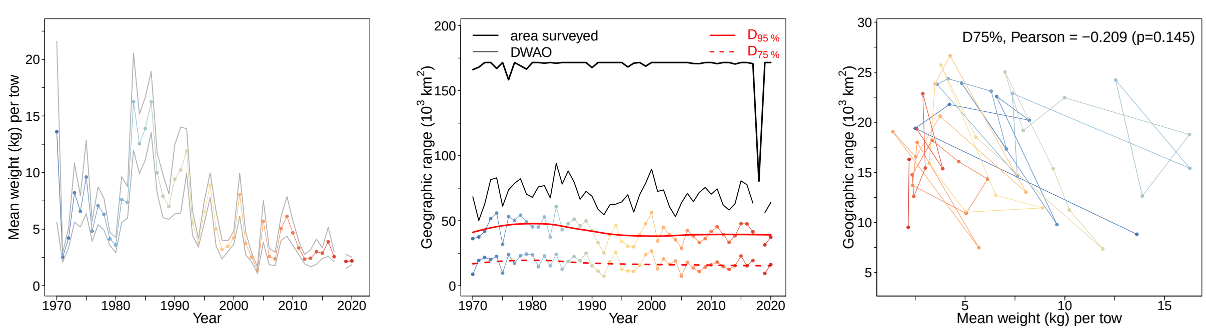



Figure 6.3B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of White hake. The predictions from a loess estimator are overlaid on the distribution indices in the middle panel.

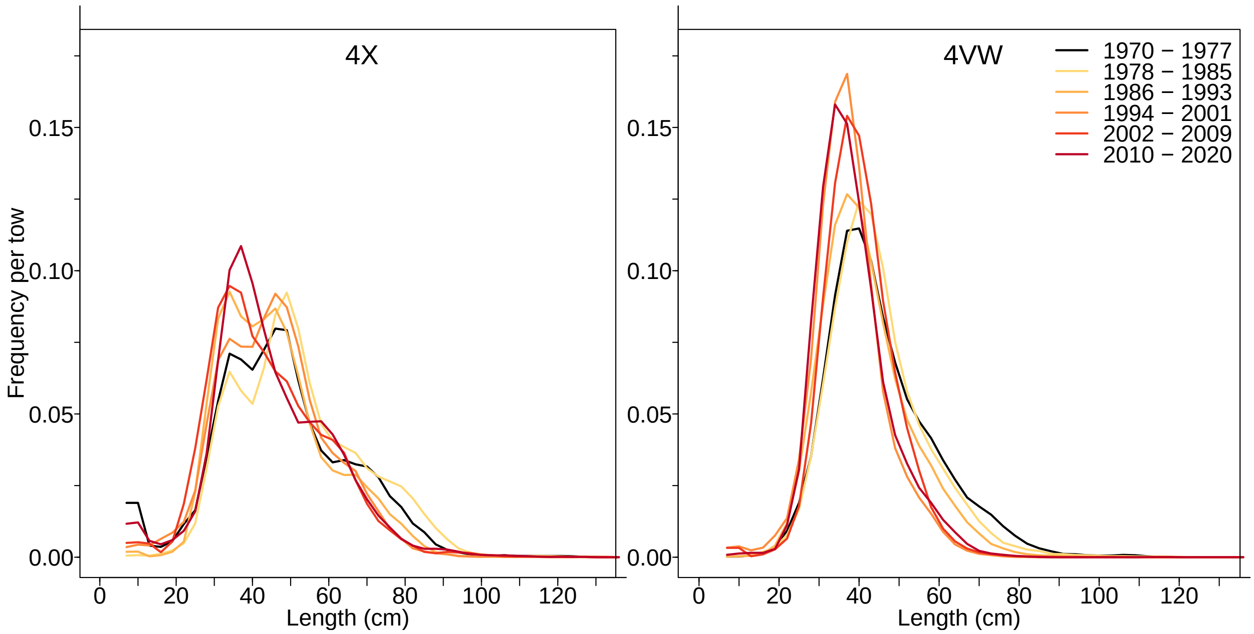



Figure 6.3C. Length frequency distribution in NAFO units 4X and 4VW for White hake.

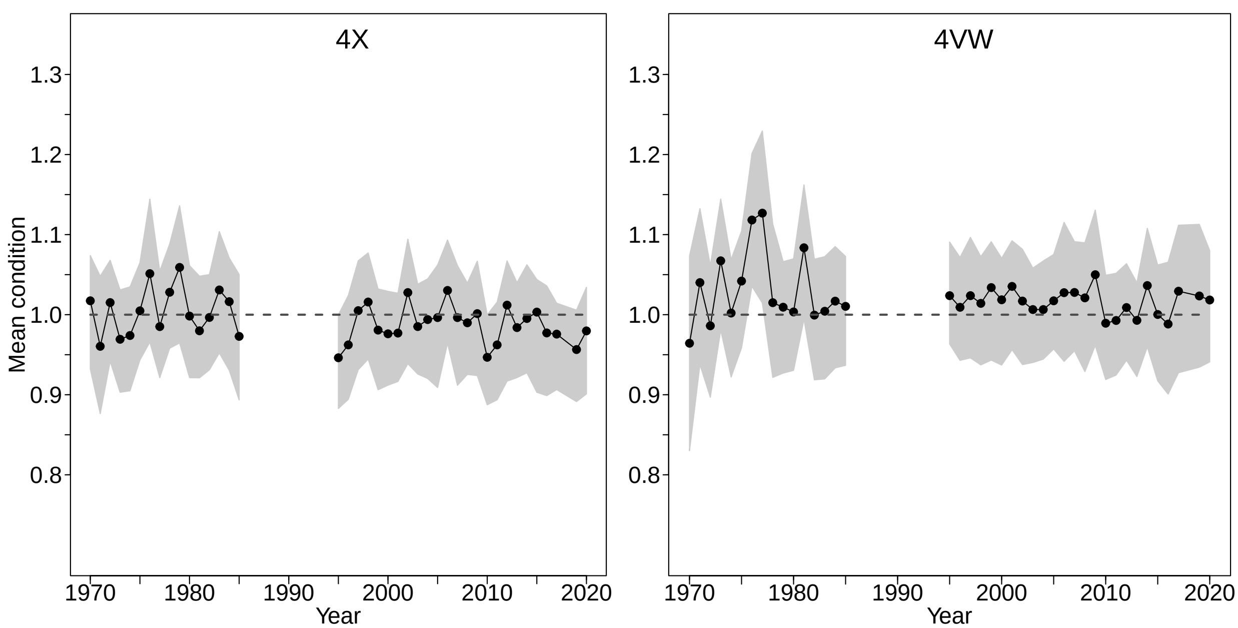
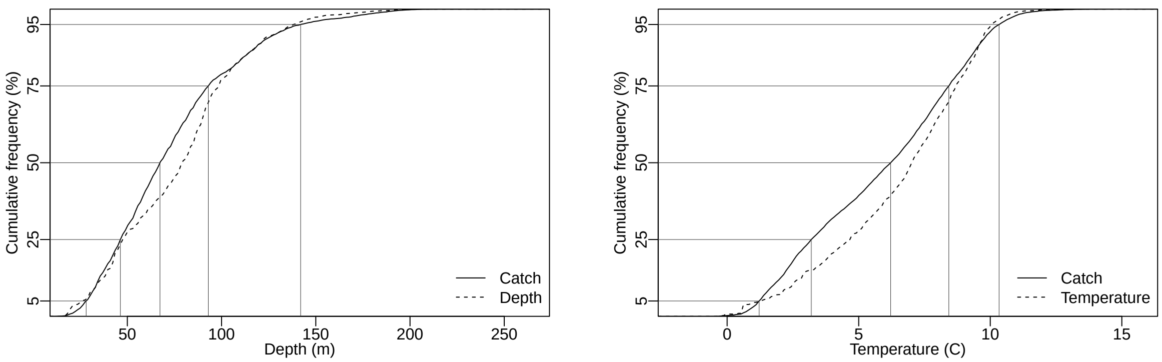
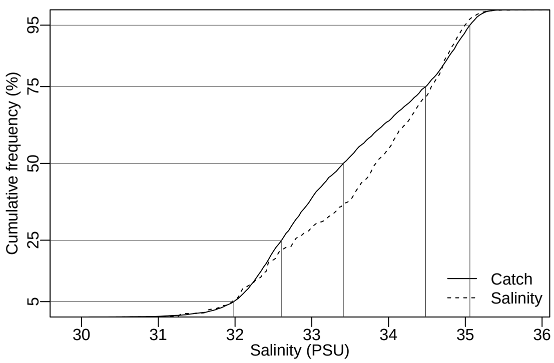



Figure 6.3D. Average fish condition in NAFO units 4X and 4VW for White hake.




| Frequency | Depth | Temperature | Salinity |
|---|---|---|---|
| 0.05 | 25 | 1.2 | 31.95 |
| 0.25 | 46 | 4.6 | 32.76 |
| 0.50 | 78 | 7.0 | 33.81 |
| 0.75 | 98 | 8.6 | 34.53 |
| 0.95 | 137 | 10.0 | 34.99 |

Figure 6.3E. Catch distribution by depth, temperature and salinity of White hake.

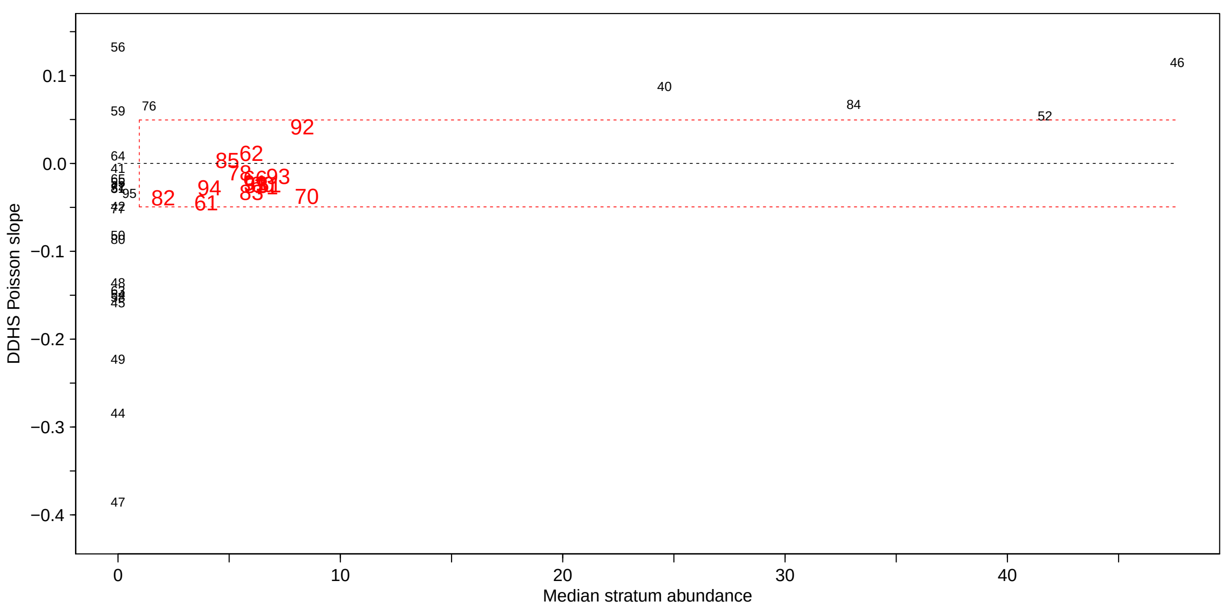



Figure 6.3F. DDHS slopes versus median stratum abundance for White hake. The last two digits of each stratum number is shown in the figure. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance.

## 6.4 Red hake (Merluche écureuil) - species code 13 (category LF)

Scientific name: [Urophycis chuss]

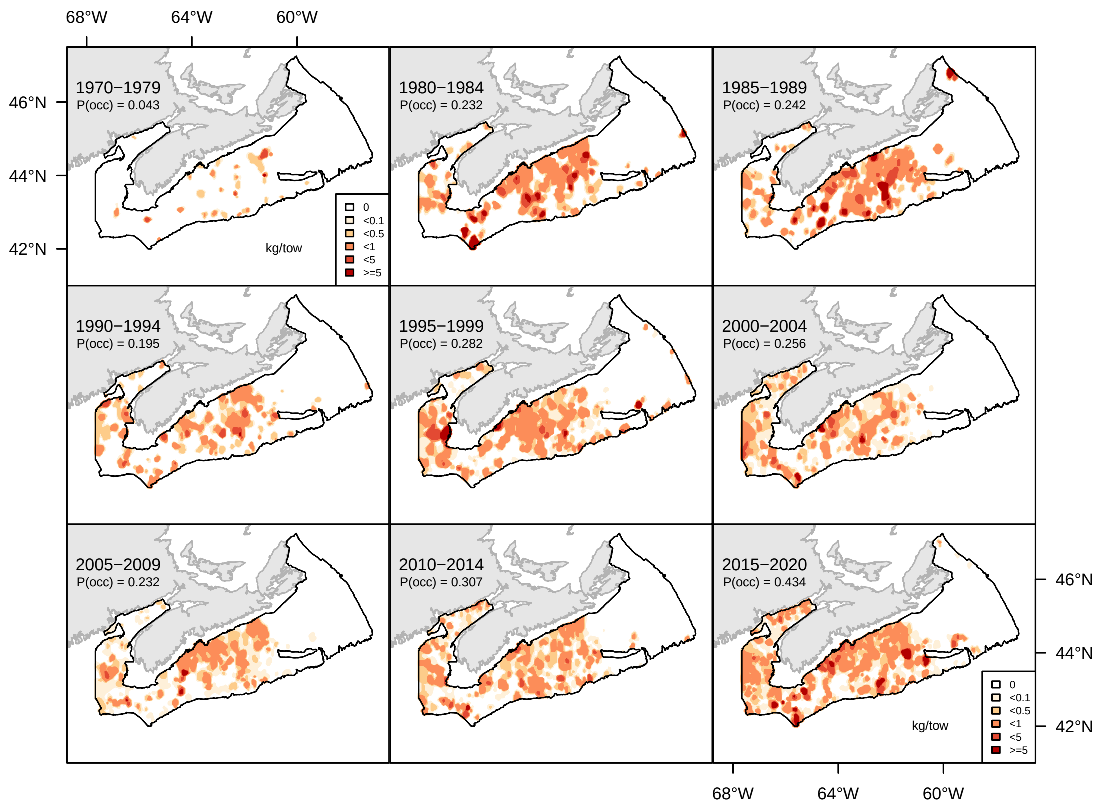



Figure 6.4A. Inverse distance weighted distribution of catch biomass (kg/tow) for Red hake. $P(occ)$ is the proportion of tows with catch records for each 5-year period.

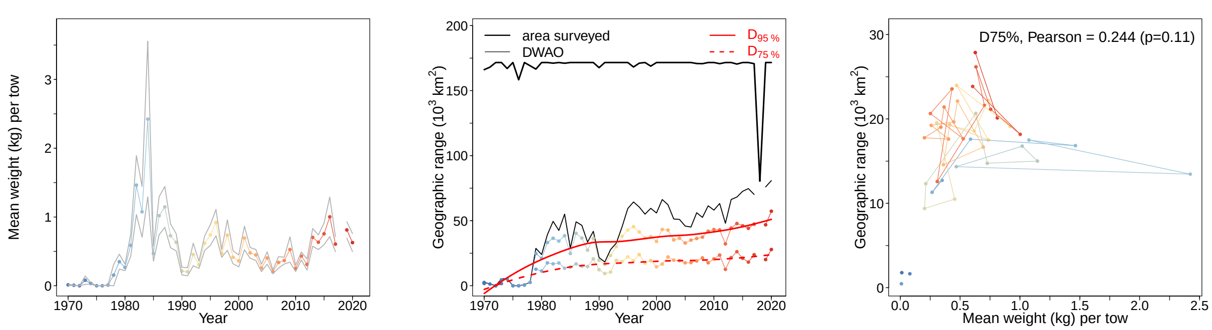



Figure 6.4B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Red hake. The predictions from a loess estimator are overlaid on the distribution indices in the middle panel.

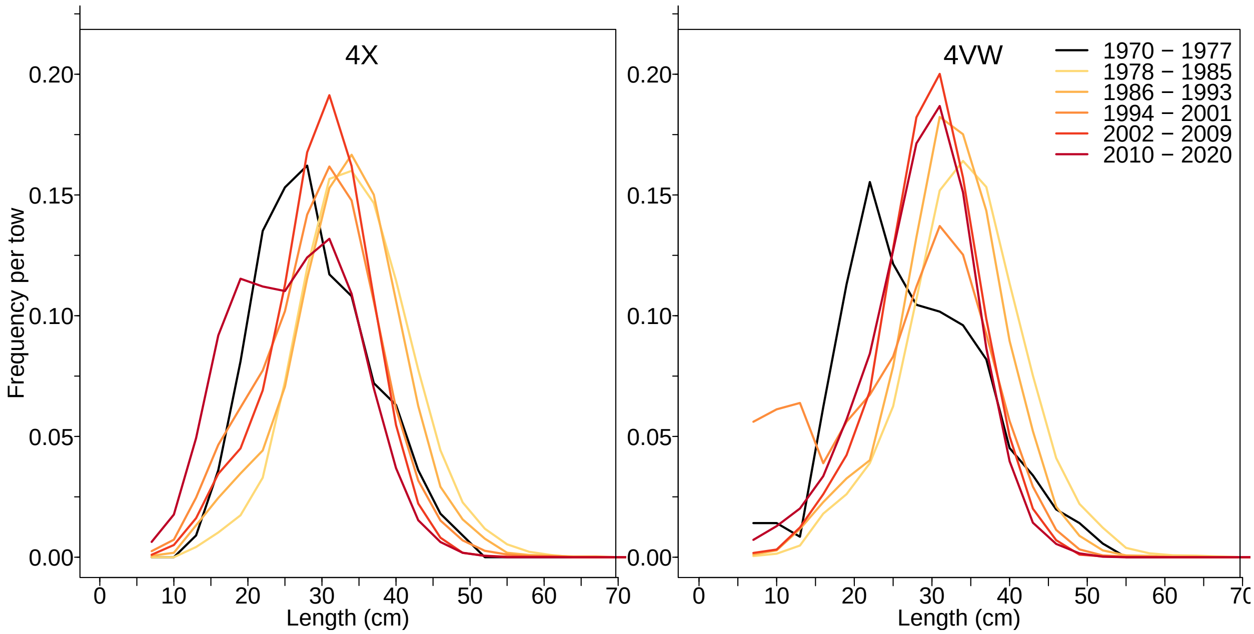



Figure 6.4C. Length frequency distribution in NAFO units 4X and 4VW for Red hake.

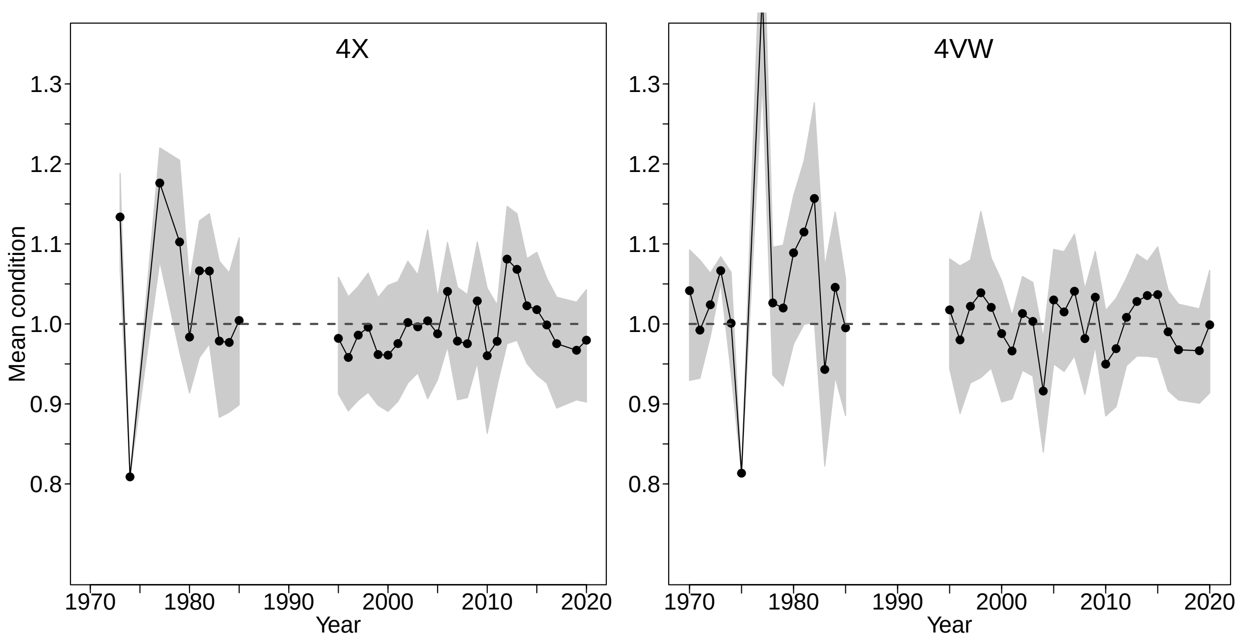
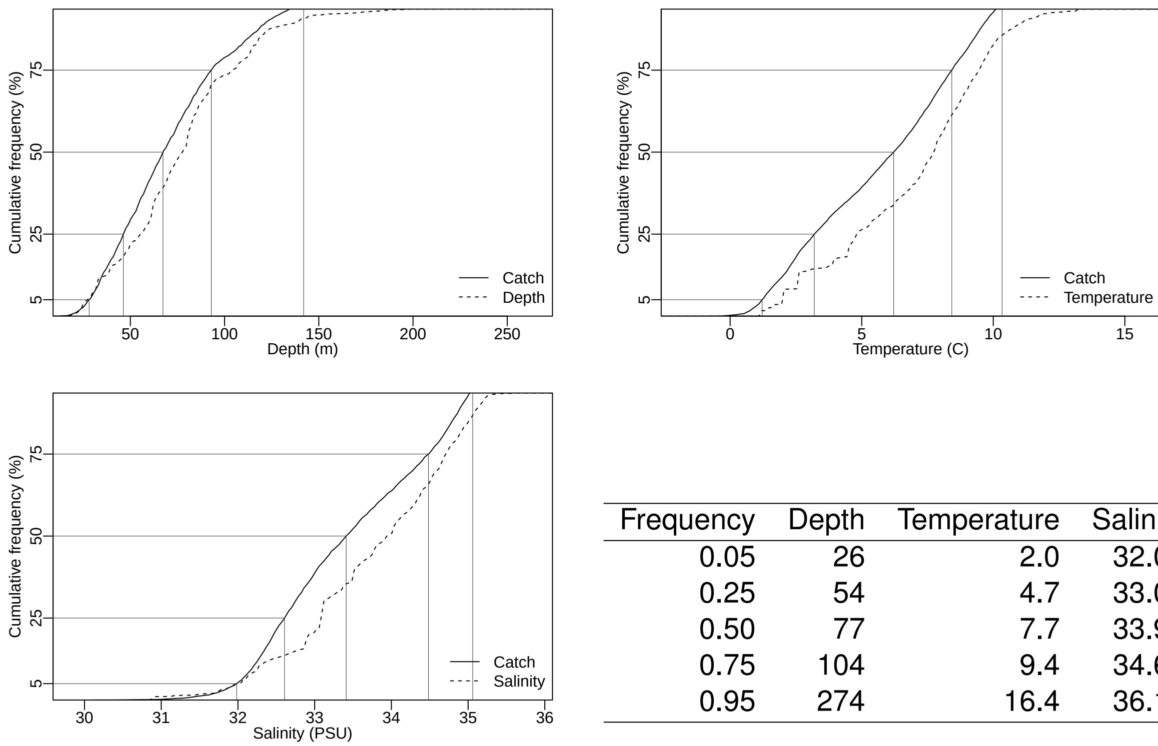



Figure 6.4D. Average fish condition in NAFO units 4X and 4VW for Red hake.




| Frequency | Depth | Temperature | Salinity |
|---|---|---|---|
| 0.05 | 26 | 2.0 | 32.01 |
| 0.25 | 54 | 4.7 | 33.06 |
| 0.50 | 77 | 7.7 | 33.94 |
| 0.75 | 104 | 9.4 | 34.69 |
| 0.95 | 274 | 16.4 | 36.10 |

Figure 6.4E. Catch distribution by depth, temperature and salinity of Red hake.

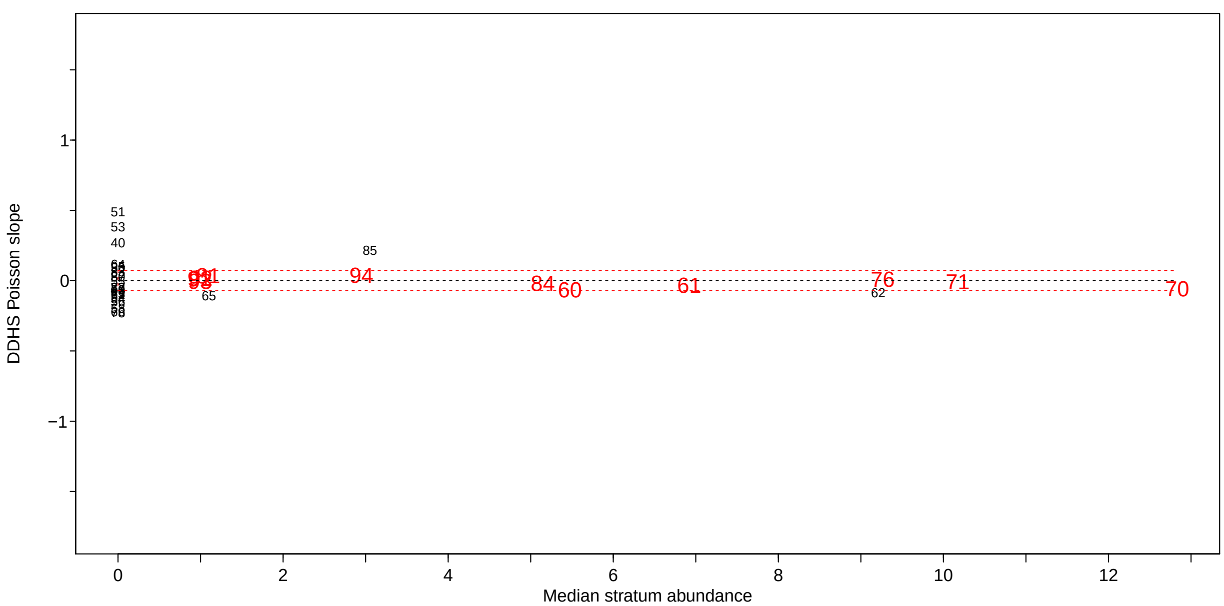



Figure 6.4F. DDHS slopes versus median stratum abundance for Red hake. The last two digits of each stratum number is shown in the figure. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance.

### 6.5 Silver hake (Merlu argenté) - species code 14 (category LF)

Scientific name: [Merluccius bilinearis]

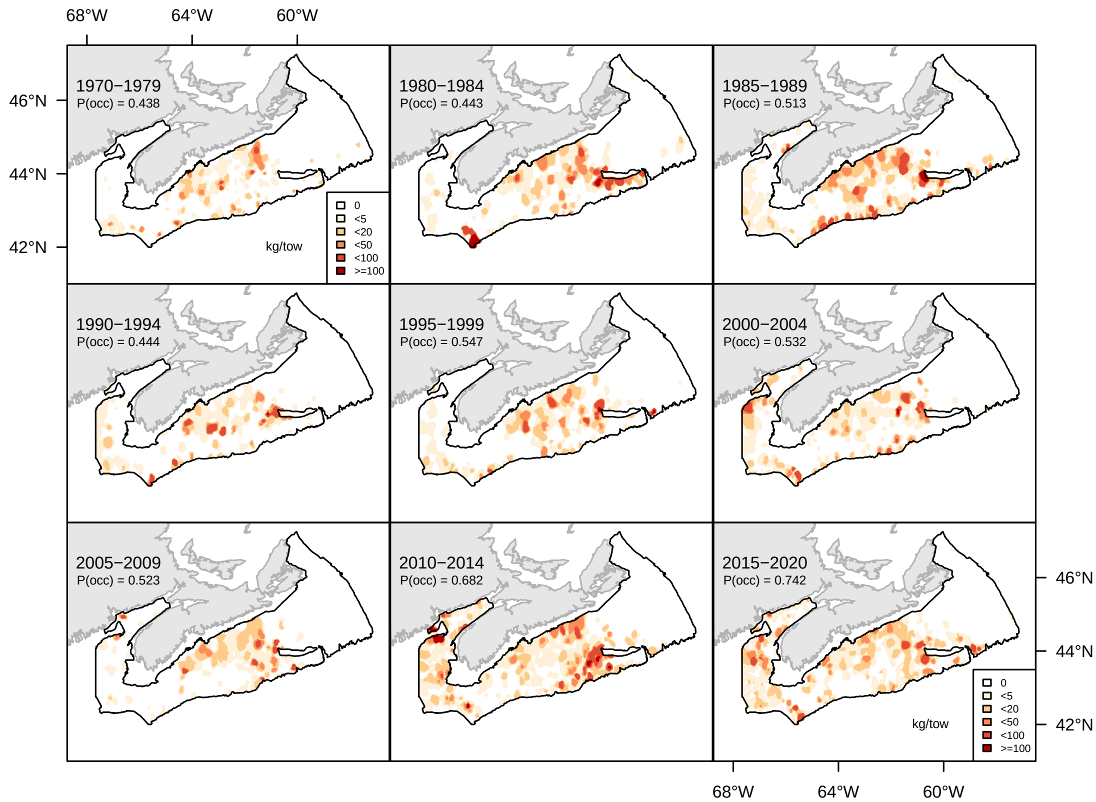



Figure 6.5A. Inverse distance weighted distribution of catch biomass (kg/tow) for Silver hake. $P(occ)$ is the proportion of tows with catch records for each 5-year period.

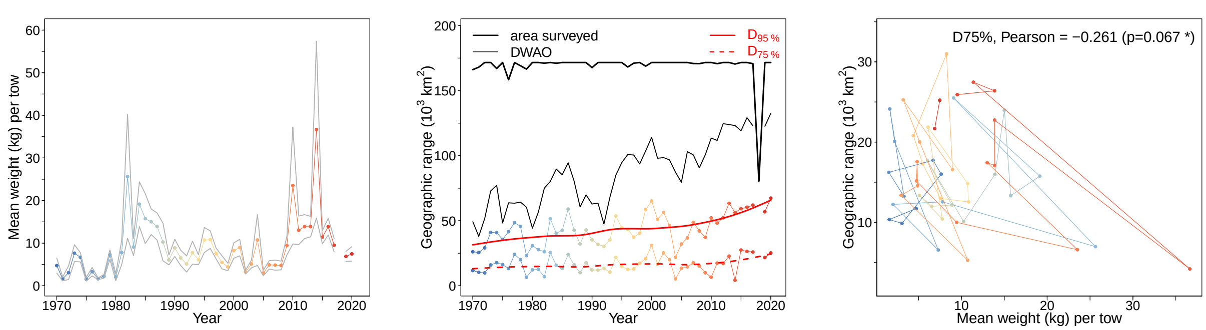



Figure 6.5B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Silver hake. The predictions from a loess estimator are overlaid on the distribution indices in the middle panel.

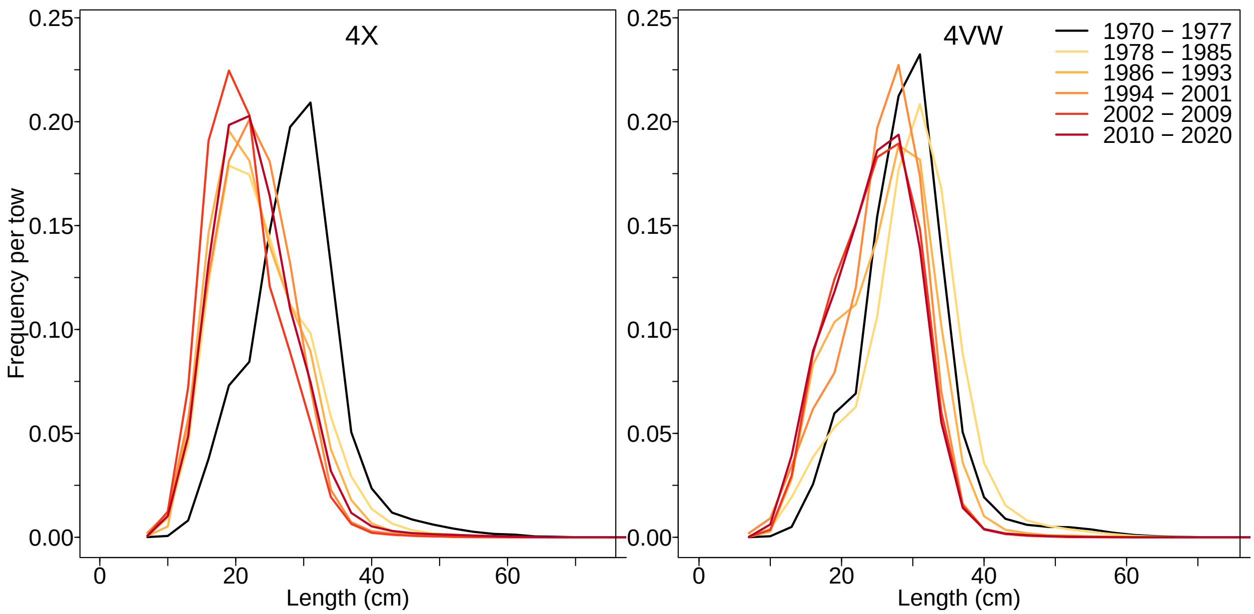



Figure 6.5C. Length frequency distribution in NAFO units 4X and 4VW for Silver hake.

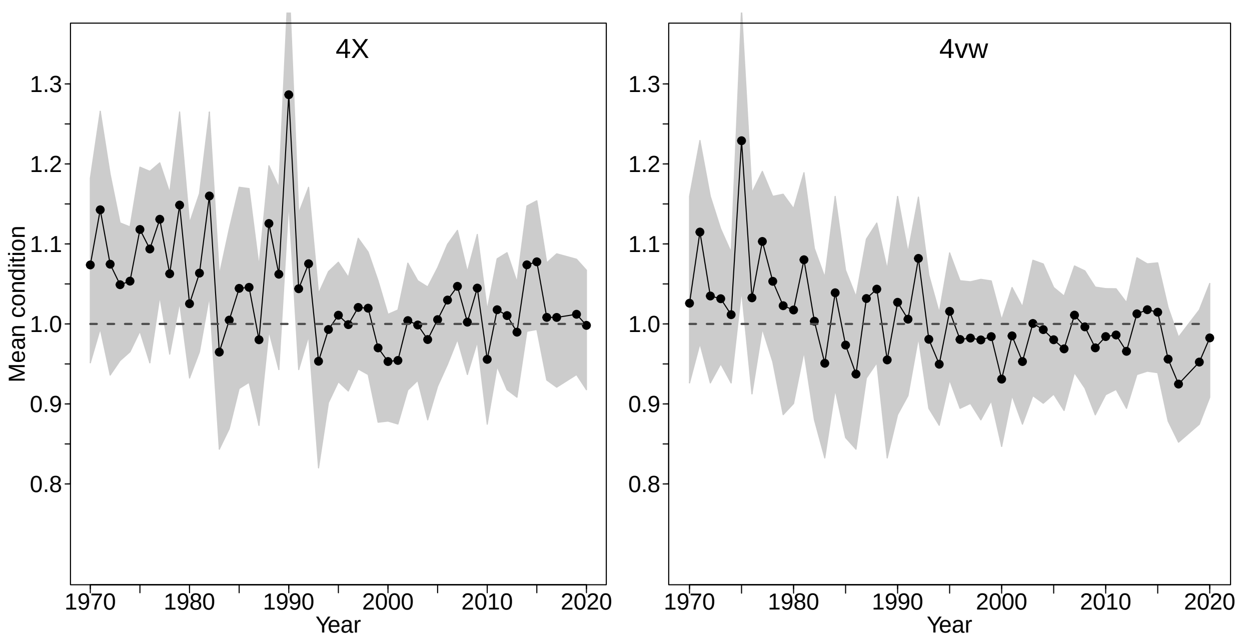
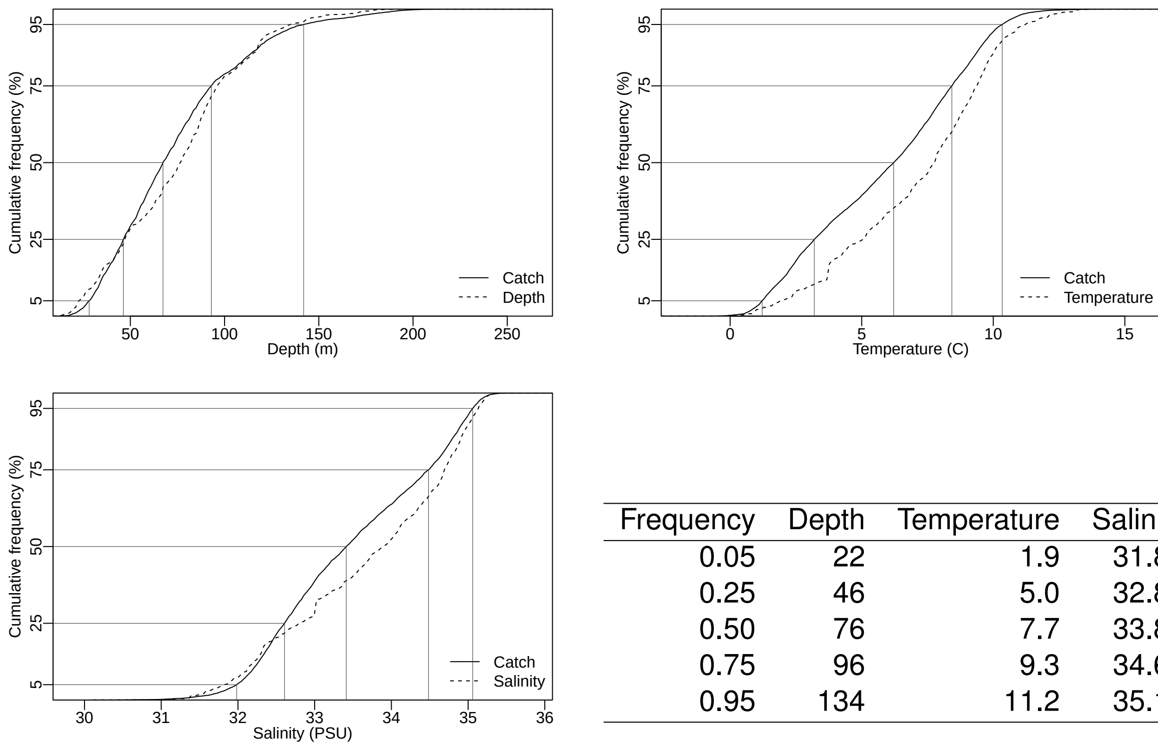



Figure 6.5D. Average fish condition in NAFO units 4X and 4VW for Silver hake.




| Frequency | Depth | Temperature | Salinity |
|---|---|---|---|
| 0.05 | 22 | 1.9 | 31.81 |
| 0.25 | 46 | 5.0 | 32.80 |
| 0.50 | 76 | 7.7 | 33.88 |
| 0.75 | 96 | 9.3 | 34.66 |
| 0.95 | 134 | 11.2 | 35.12 |

Figure 6.5E. Catch distribution by depth, temperature and salinity of Silver hake.

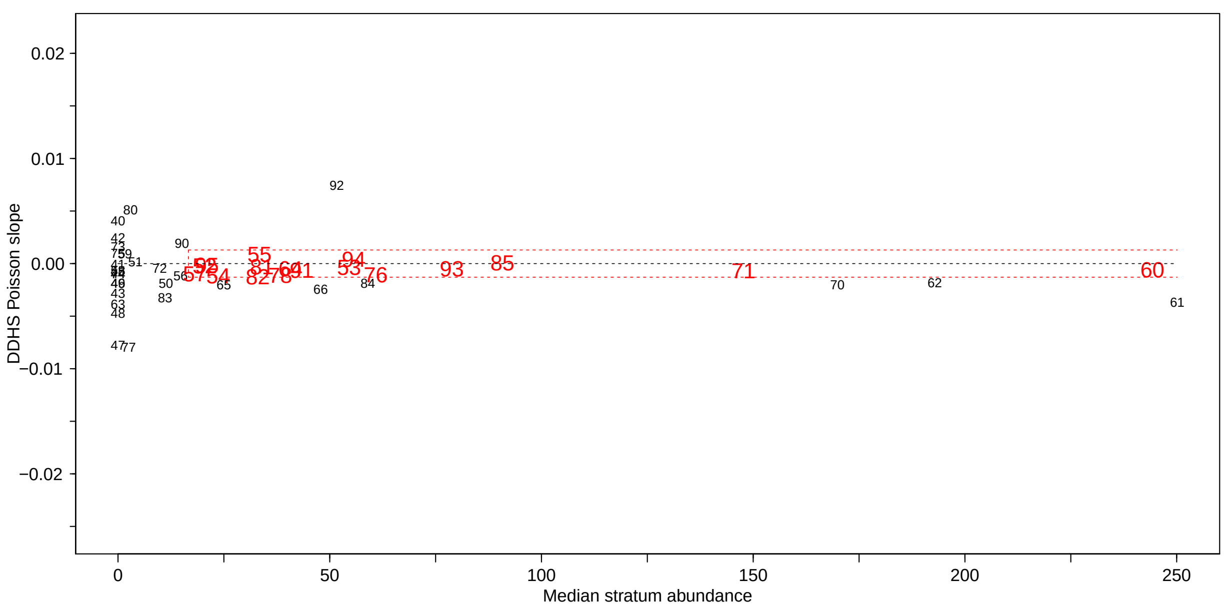



Figure 6.5F. DDHS slopes versus median stratum abundance for Silver hake. The last two digits of each stratum number is shown in the figure. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance.

## 6.6 Pollock (Goberge) - species code 16 (category LF)

Scientific name: Pollachius virens

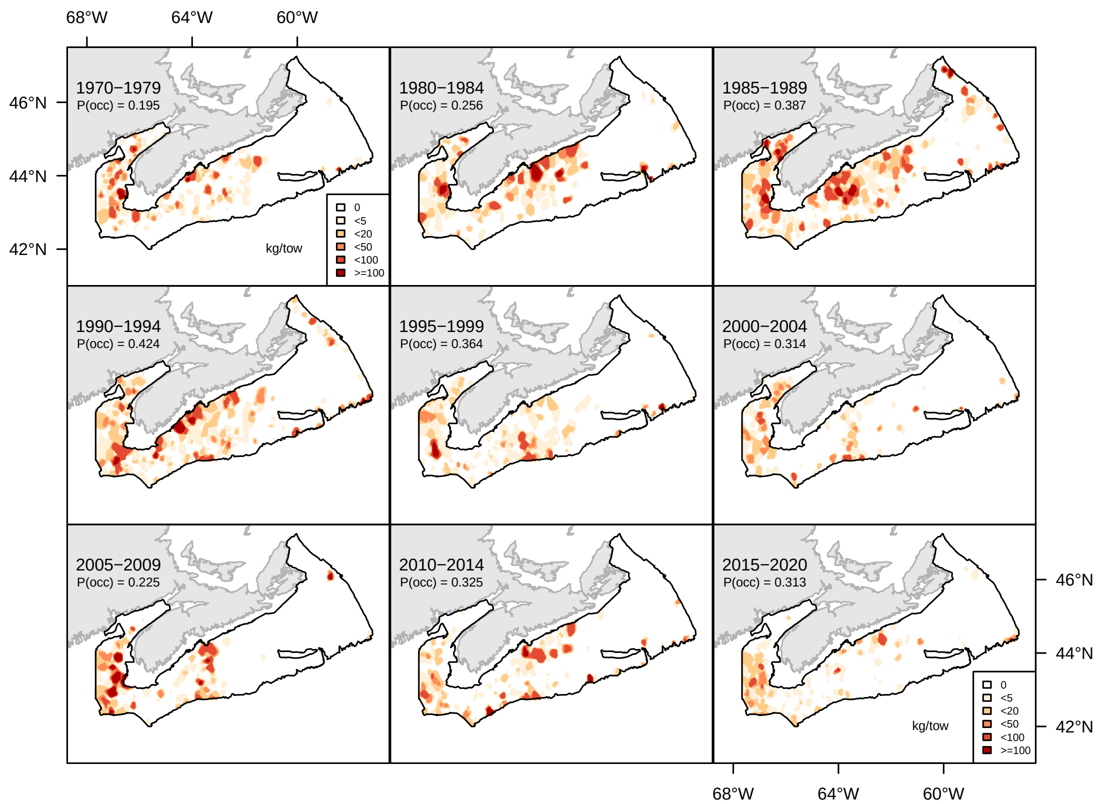



Figure 6.6A. Inverse distance weighted distribution of catch biomass (kg/tow) for Pollock. $P(occ)$ is the proportion of tows with catch records for each 5-year period.

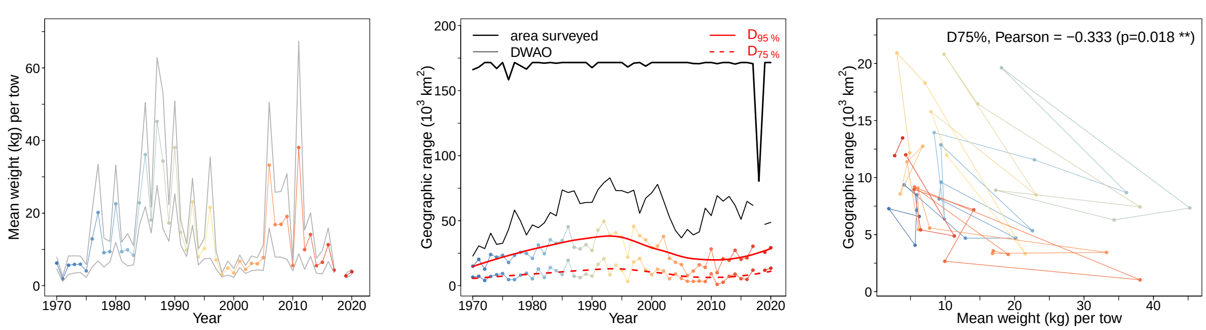



Figure 6.6B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Pollock. The predictions from a loess estimator are overlaid on the distribution indices in the middle panel.

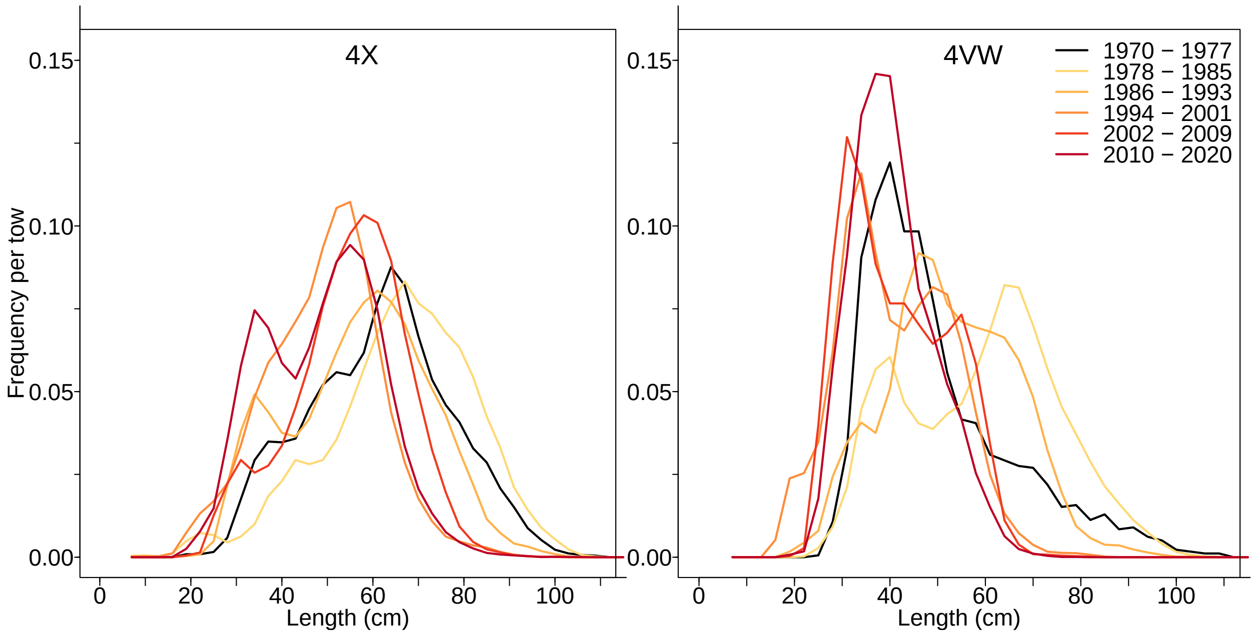



Figure 6.6C. Length frequency distribution in NAFO units 4X and 4VW for Pollock.

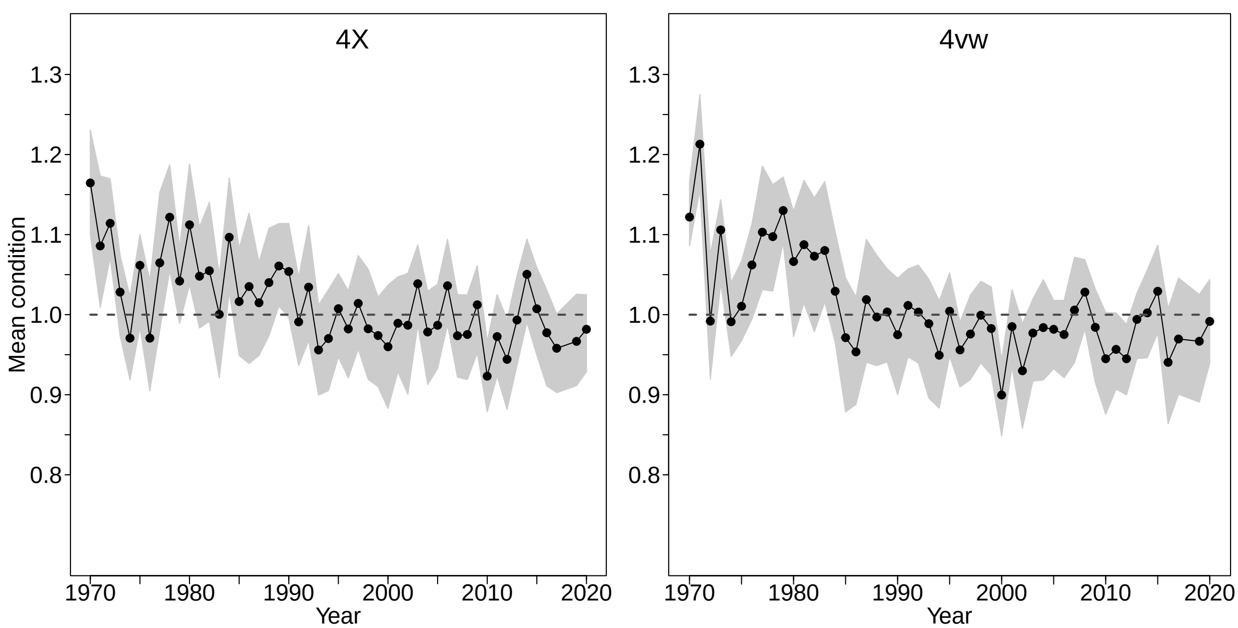
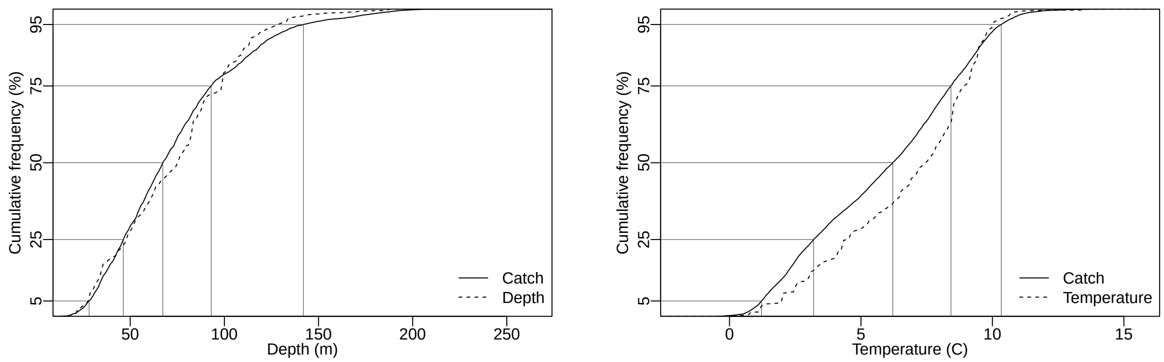
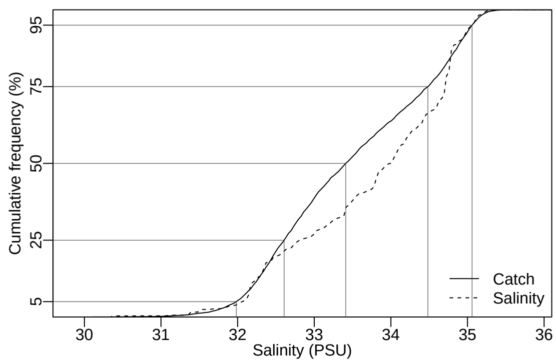



Figure 6.6D. Average fish condition in NAFO units 4X and 4VW for Pollock.




| Frequency | Depth | Temperature | Salinity |
|---|---|---|---|
| 0.05 | 28 | 2.0 | 32.04 |
| 0.25 | 48 | 4.4 | 32.80 |
| 0.50 | 74 | 7.4 | 33.97 |
| 0.75 | 98 | 8.9 | 34.69 |
| 0.95 | 128 | 10.0 | 35.05 |

Figure 6.6E. Catch distribution by depth, temperature and salinity of Pollock.

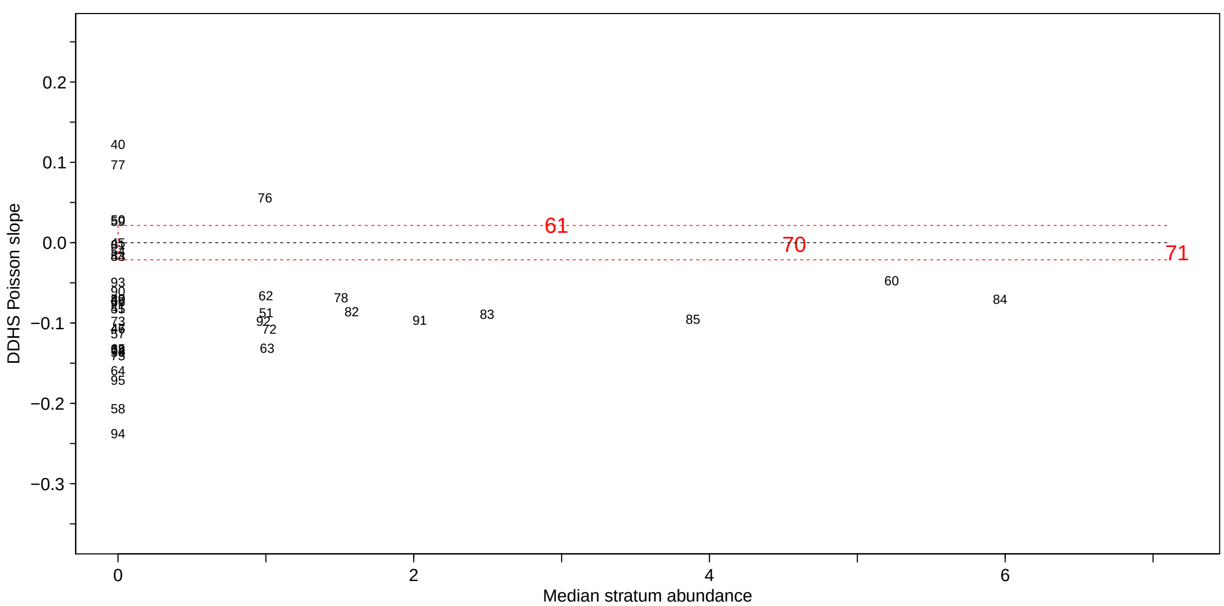



Figure 6.6F. DDHS slopes versus median stratum abundance for Pollock. The last two digits of each stratum number is shown in the figure. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance.

## 6.7 Sea raven (Hémitriptère atlantique) - species code 320 (category LF)

Scientific name: Hemitripterus americanus

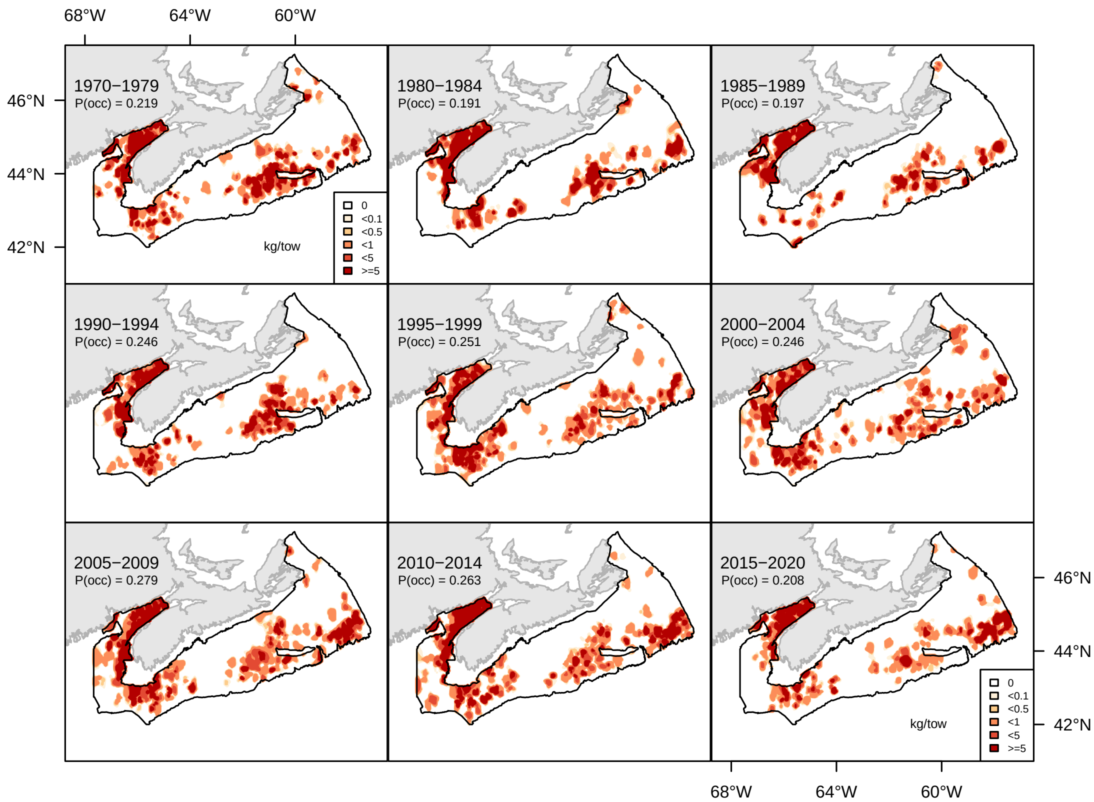



Figure 6.7A. Inverse distance weighted distribution of catch biomass (kg/tow) for Sea raven. $P(occ)$ is the proportion of tows with catch records for each 5-year period.

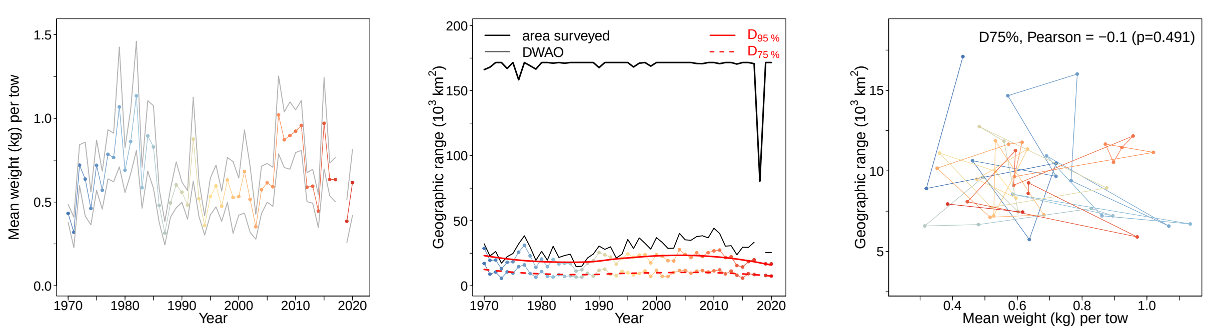



Figure 6.7B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Sea raven. The predictions from a loess estimator are overlaid on the distribution indices in the middle panel.

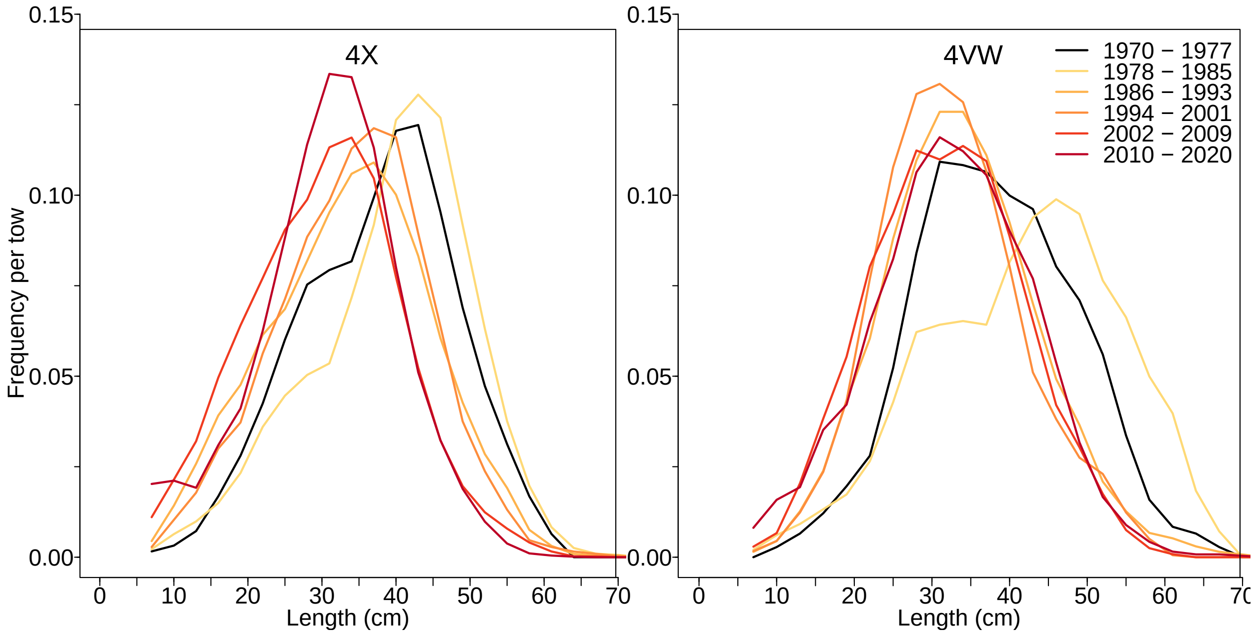



Figure 6.7C. Length frequency distribution in NAFO units 4X and 4VW for Sea raven.

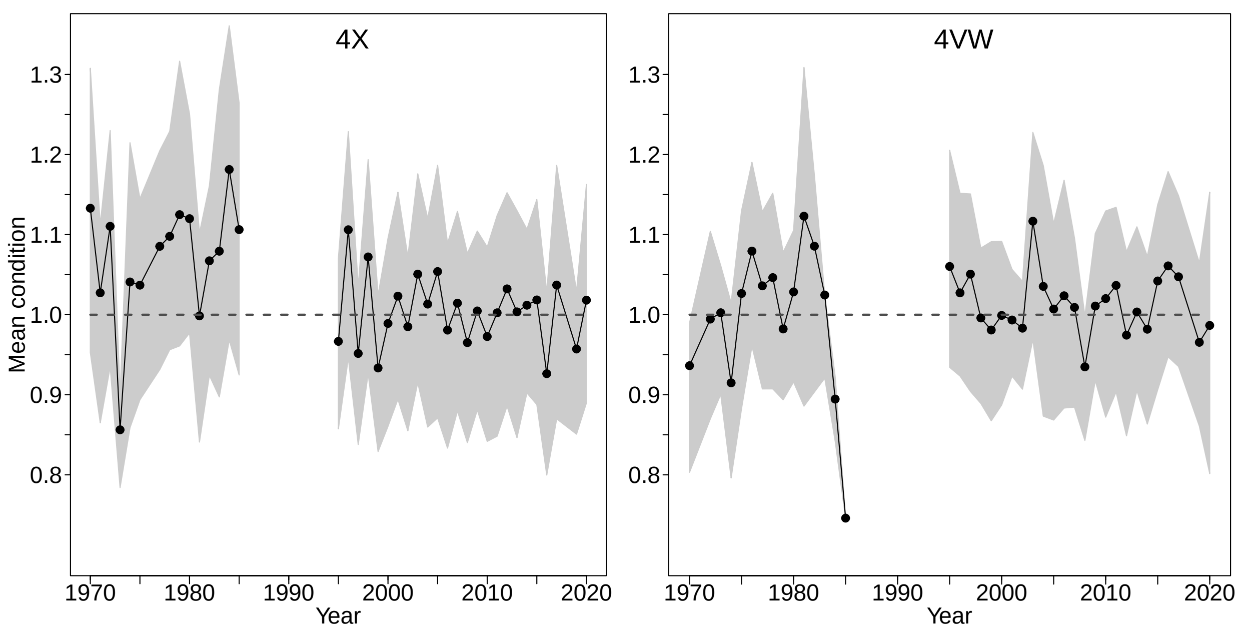
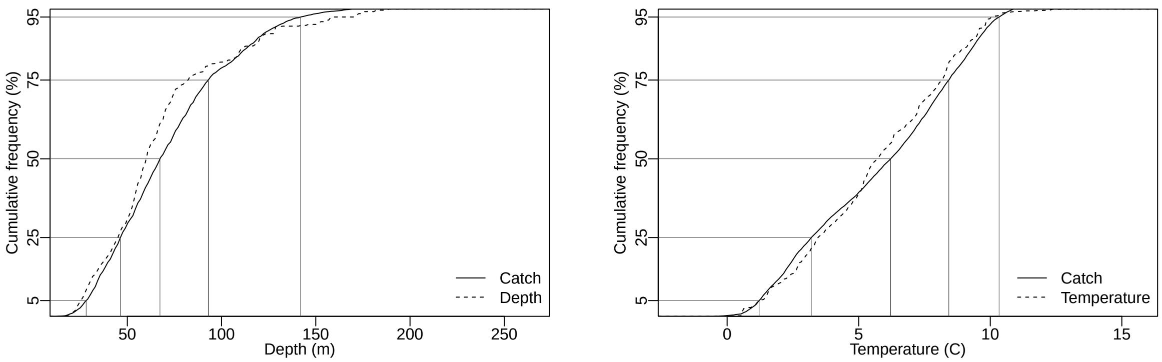
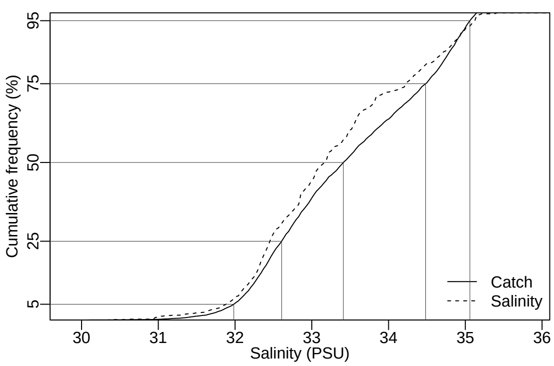



Figure 6.7D. Average fish condition in NAFO units 4X and 4VW for Sea raven.




| Frequency | Depth | Temperature | Salinity |
|---|---|---|---|
| 0.05 | 25 | 1.1 | 31.88 |
| 0.25 | 45 | 3.4 | 32.44 |
| 0.50 | 60 | 5.7 | 33.16 |
| 0.75 | 81 | 8.2 | 34.20 |
| 0.95 | 157 | 10.0 | 35.12 |

Figure 6.7E. Catch distribution by depth, temperature and salinity of Sea raven.

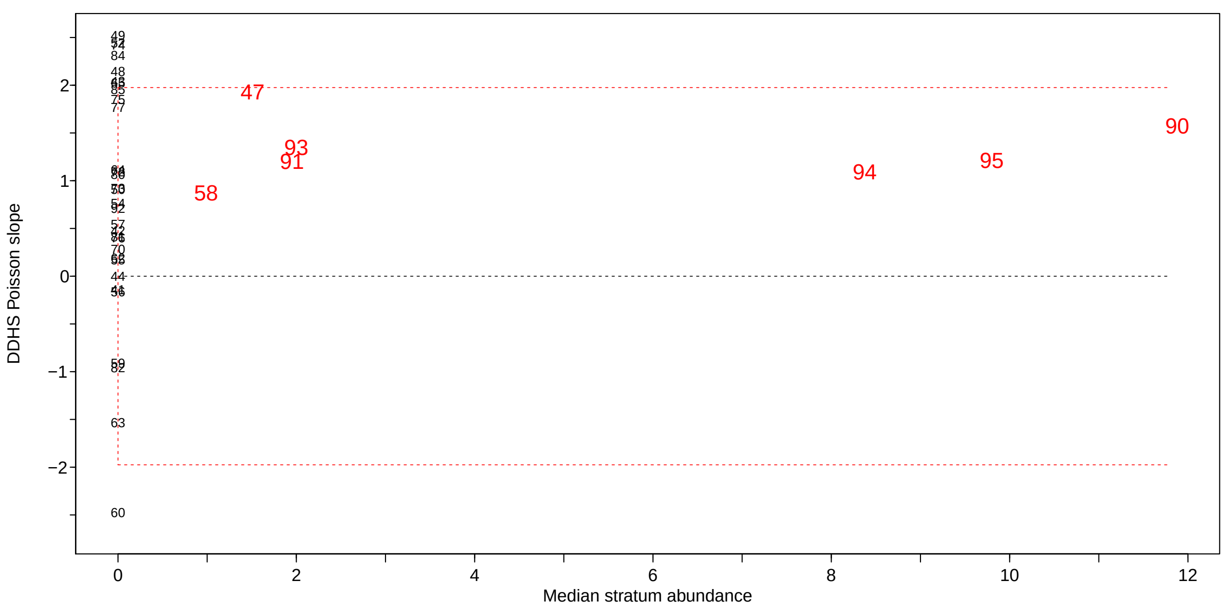



Figure 6.7F. DDHS slopes versus median stratum abundance for Sea raven. The last two digits of each stratum number is shown in the figure. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance.

## 6.8 Atlantic halibut (Flétan de l'Atlantique) - species code 30 (category LF)

Scientific name: Hippoglossus hippoglossus

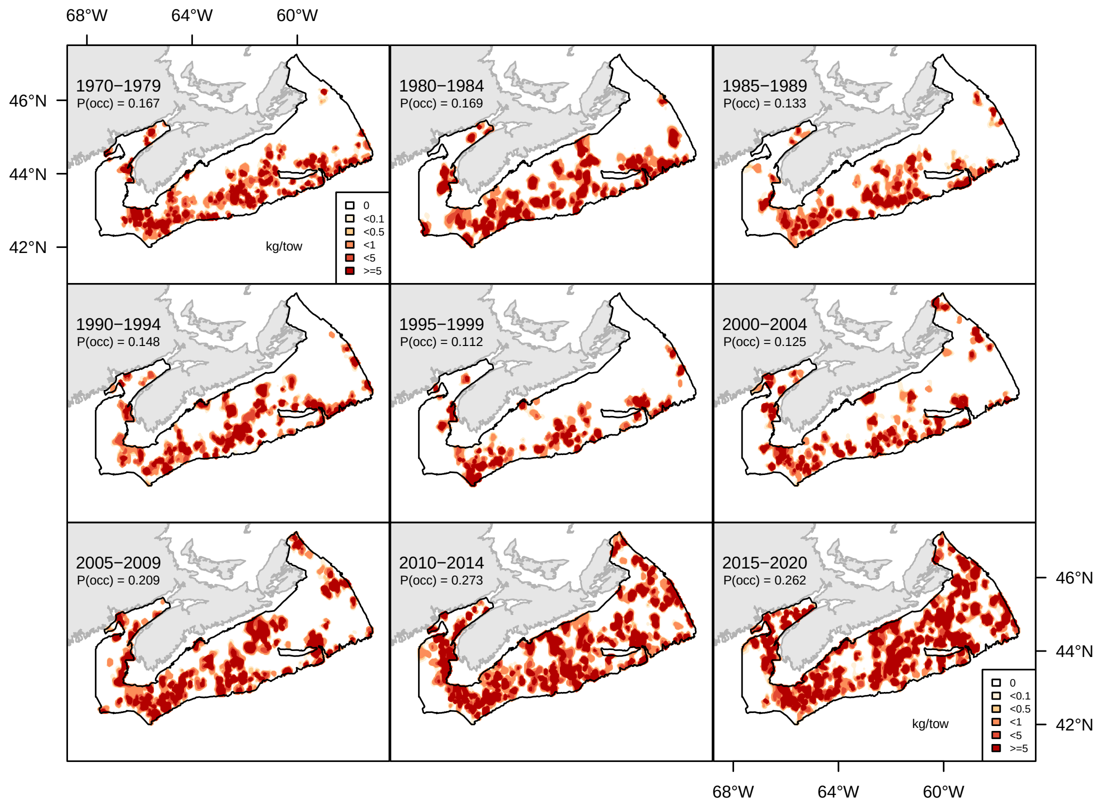



Figure 6.8A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic halibut. $P(occ)$ is the proportion of tows with catch records for each 5-year period.

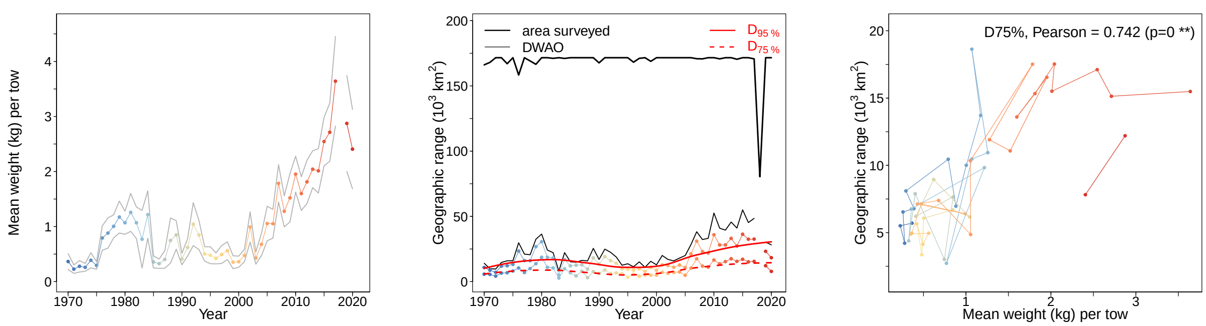



Figure 6.8B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic halibut. The predictions from a loess estimator are overlaid on the distribution indices in the middle panel.

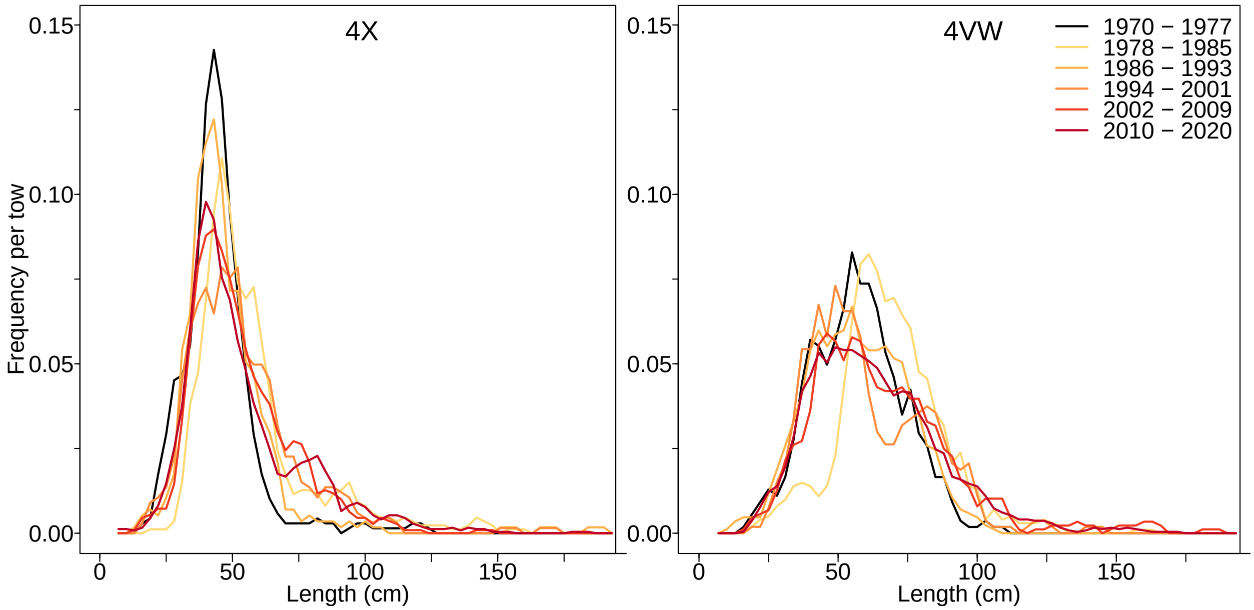



Figure 6.8C. Length frequency distribution in NAFO units 4X and 4VW for Atlantic halibut.

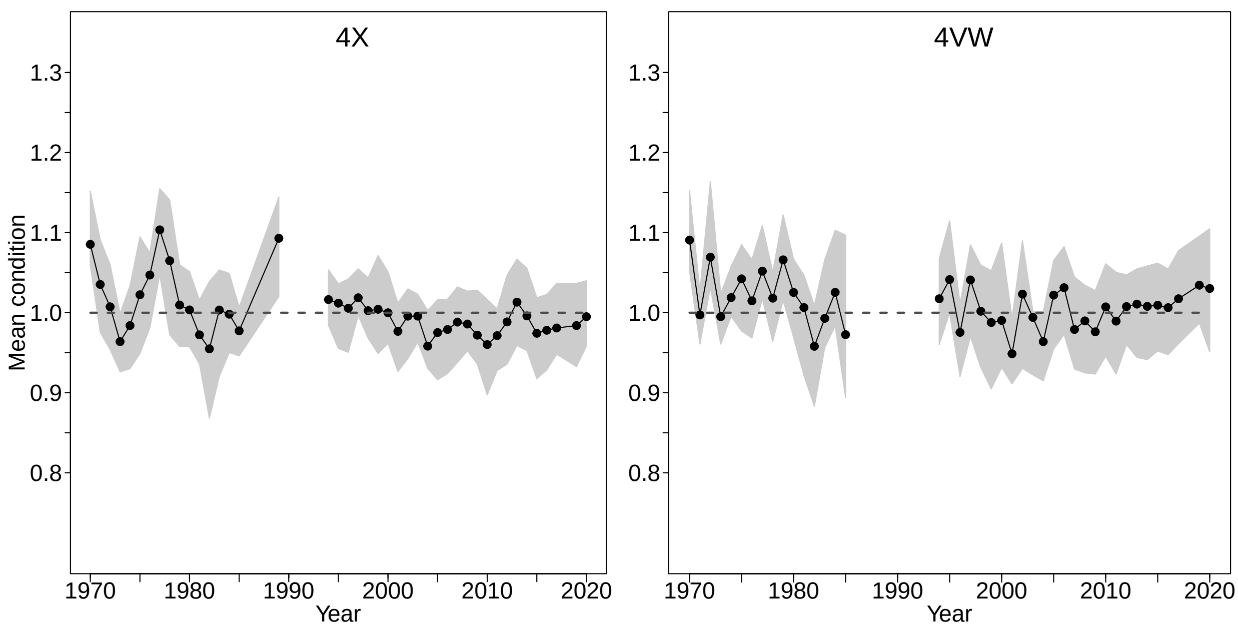
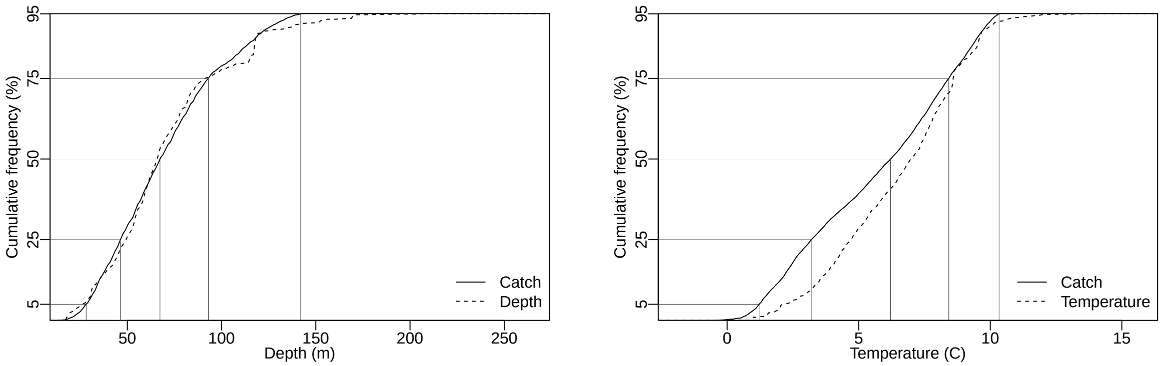
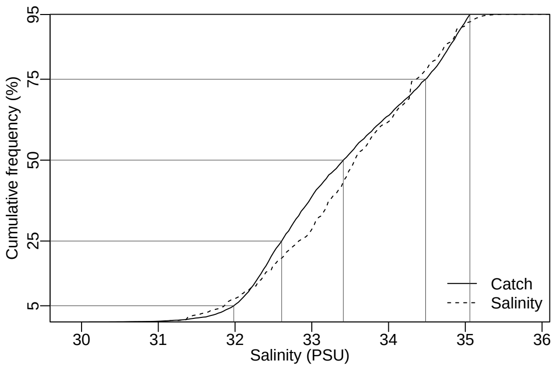



Figure 6.8D. Average fish condition in NAFO units 4X and 4VW for Atlantic halibut.




| Frequency | Depth | Temperature | Salinity |
|---|---|---|---|
| 0.05 | 25 | 2.1 | 31.85 |
| 0.25 | 49 | 4.6 | 32.83 |
| 0.50 | 65 | 6.9 | 33.55 |
| 0.75 | 90 | 8.5 | 34.33 |
| 0.95 | 205 | 13.1 | 35.38 |

Figure 6.8E. Catch distribution by depth, temperature and salinity of Atlantic halibut.

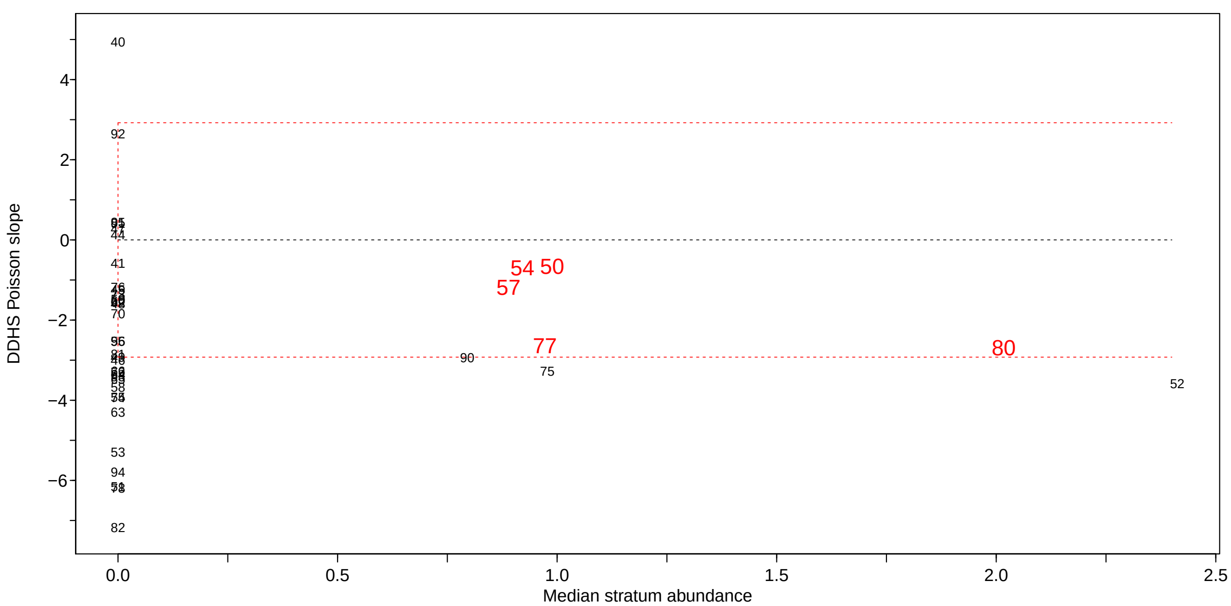



Figure 6.8F. DDHS slopes versus median stratum abundance for Atlantic halibut. The last two digits of each stratum number is shown in the figure. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance.

## 6.9 American plaice (Plie canadienne) - species code 40 (category LF)

Scientific name: Hippoglossoides platessoides

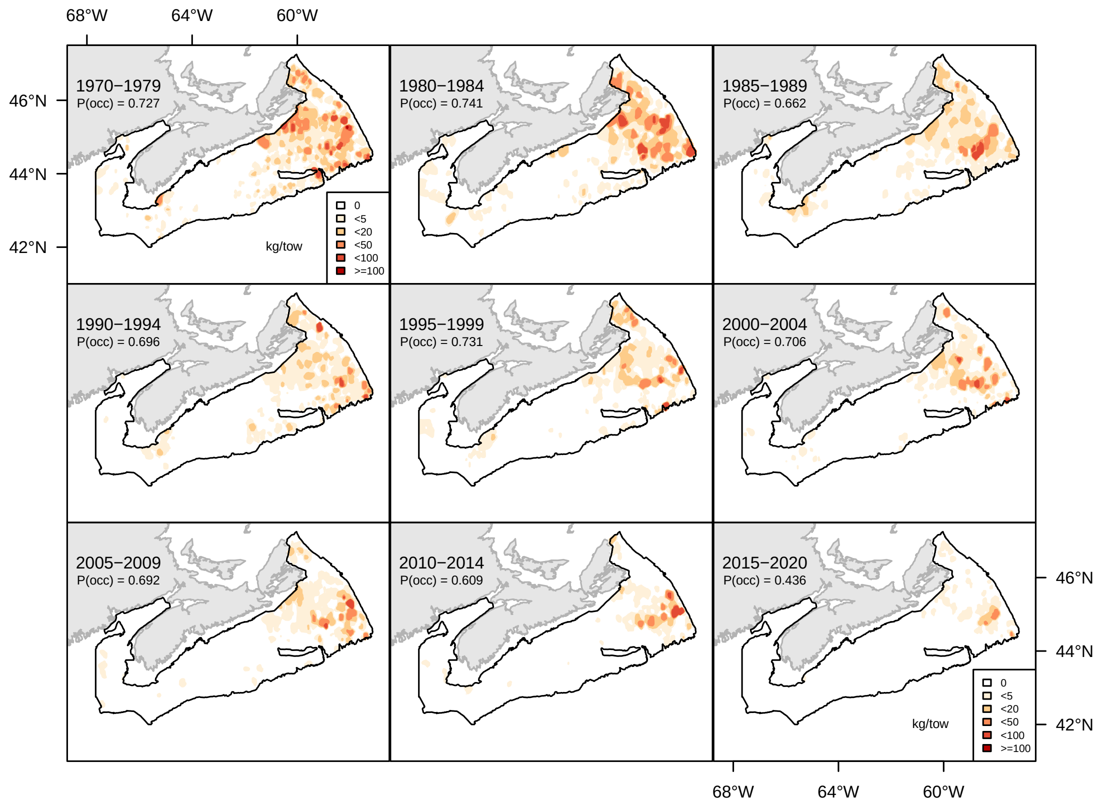



Figure 6.9A. Inverse distance weighted distribution of catch biomass (kg/tow) for American plaice. $P(occ)$ is the proportion of tows with catch records for each 5-year period.

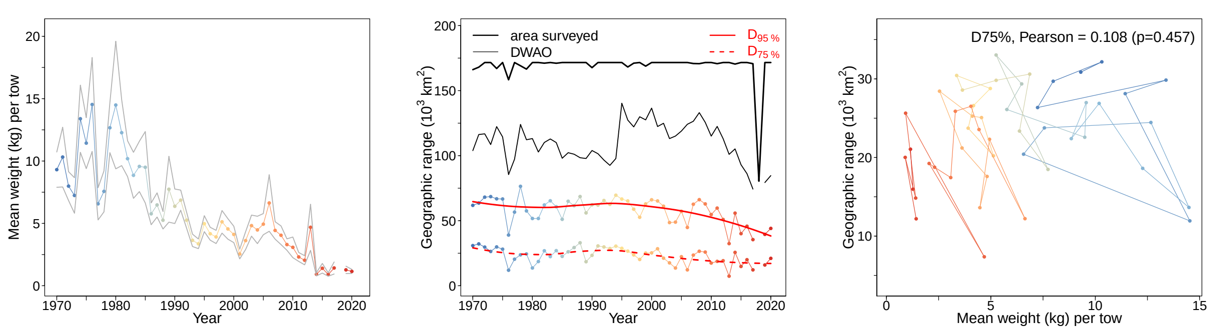



Figure 6.9B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of American plaice. The predictions from a loess estimator are overlaid on the distribution indices in the middle panel.

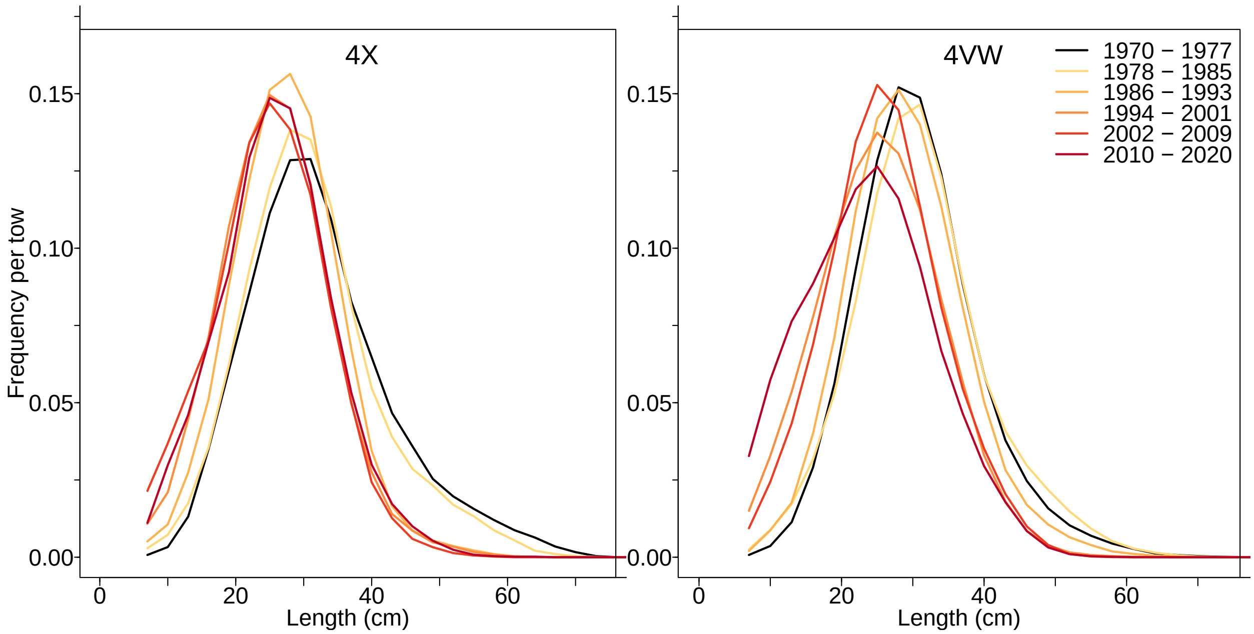



Figure 6.9C. Length frequency distribution in NAFO units 4X and 4VW for American plaice.

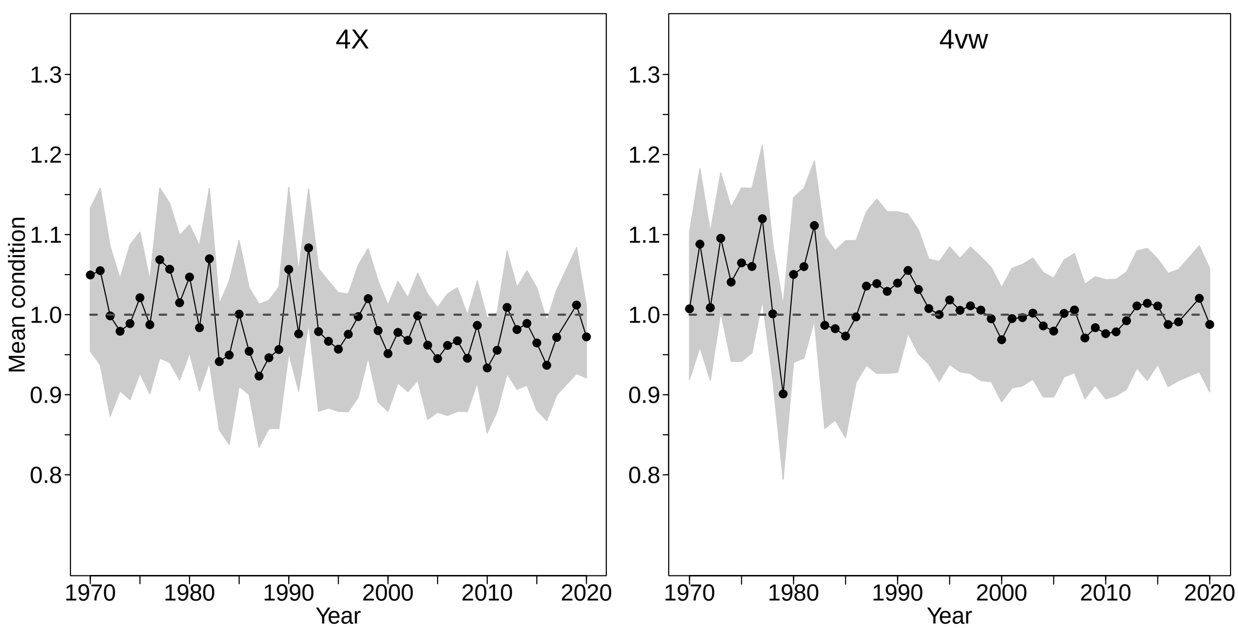
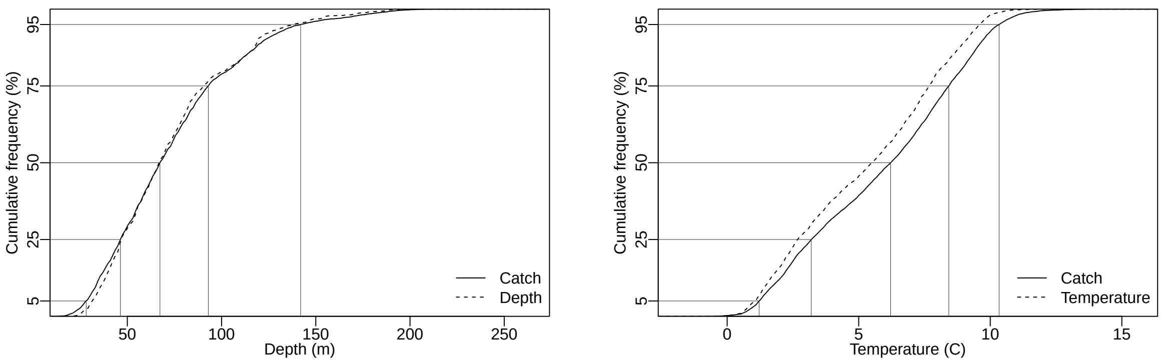
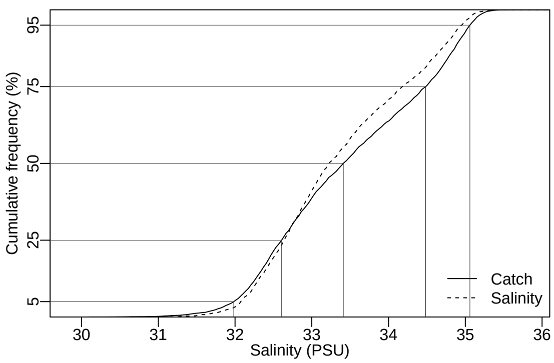



Figure 6.9D. Average fish condition in NAFO units 4X and 4VW for American plaice.




| Frequency | Depth | Temperature | Salinity |
|---|---|---|---|
| 0.05 | 30 | 1.0 | 32.04 |
| 0.25 | 46 | 2.6 | 32.63 |
| 0.50 | 66 | 5.5 | 33.19 |
| 0.75 | 90 | 7.6 | 34.17 |
| 0.95 | 138 | 9.5 | 34.92 |

Figure 6.9E. Catch distribution by depth, temperature and salinity of American plaice.

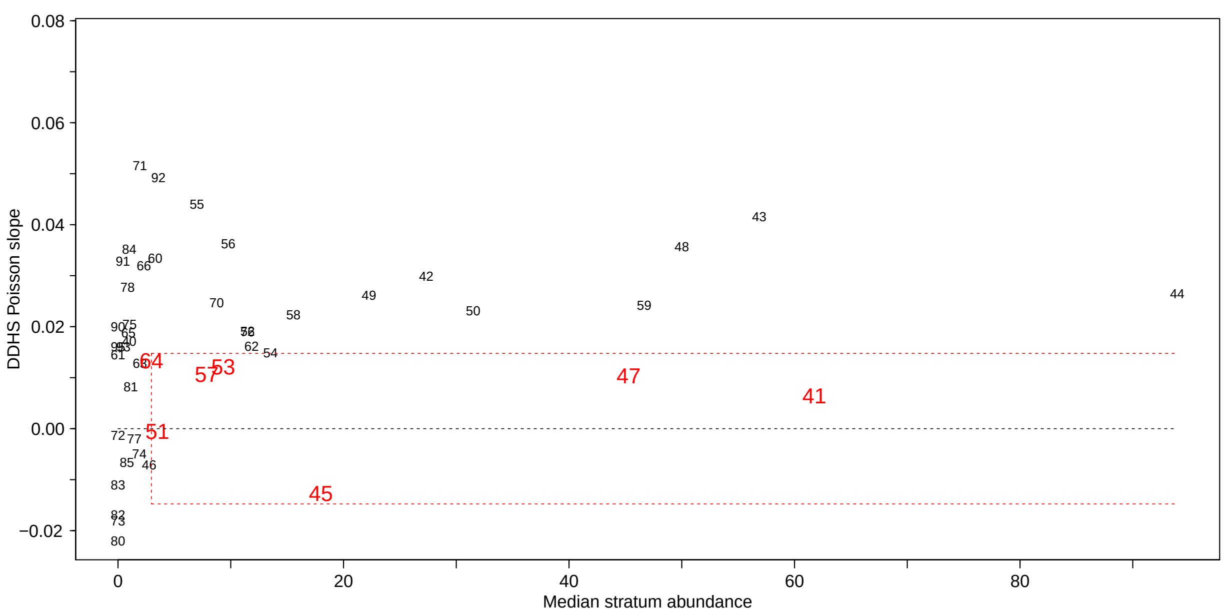



Figure 6.9F. DDHS slopes versus median stratum abundance for American plaice. The last two digits of each stratum number is shown in the figure. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance.

## 6.10 Witch flounder (Plie grise) - species code 41 (category LF)

Scientific name: Glyptocephalus cynoglossus

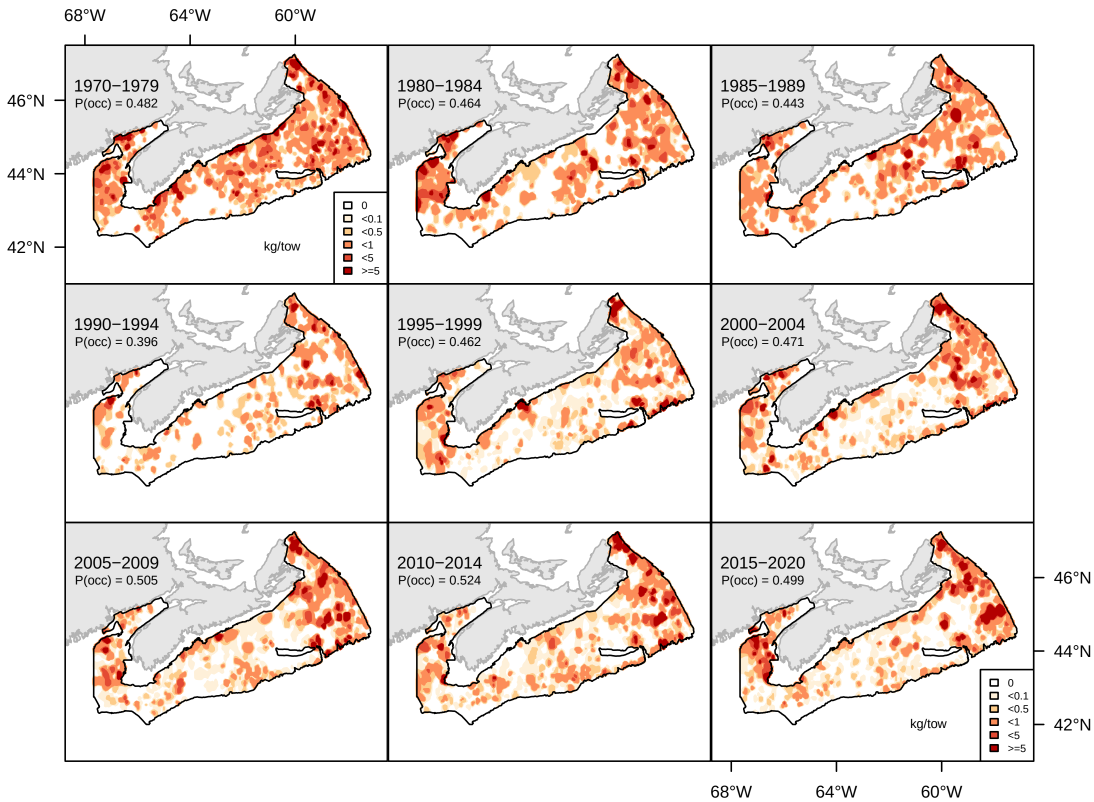



Figure 6.10A. Inverse distance weighted distribution of catch biomass (kg/tow) for Witch flounder. $P(occ)$ is the proportion of tows with catch records for each 5-year period.

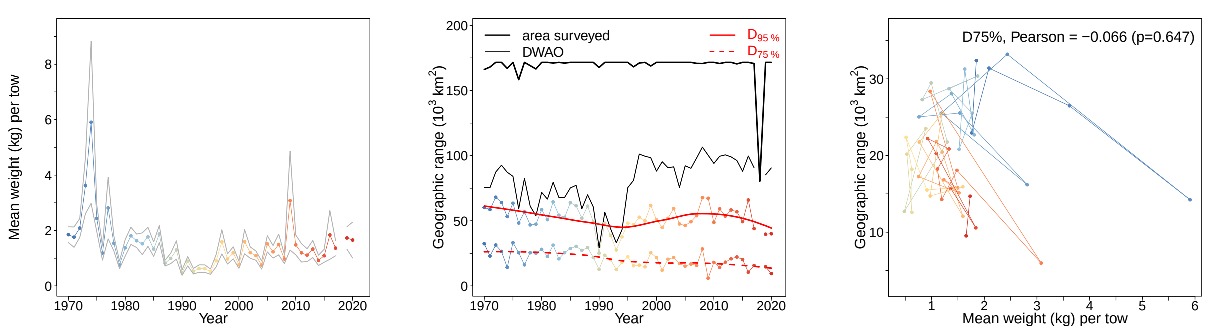



Figure 6.10B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Witch flounder. The predictions from a loess estimator are overlaid on the distribution indices in the middle panel.

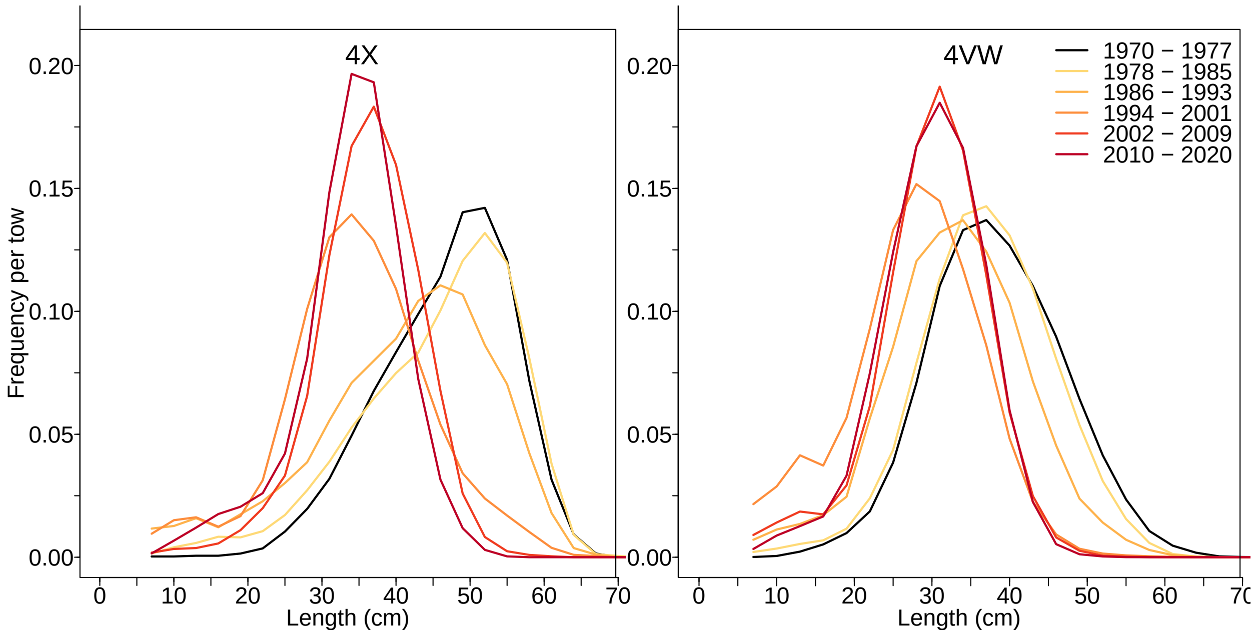



Figure 6.10C. Length frequency distribution in NAFO units 4X and 4VW for Witch flounder.

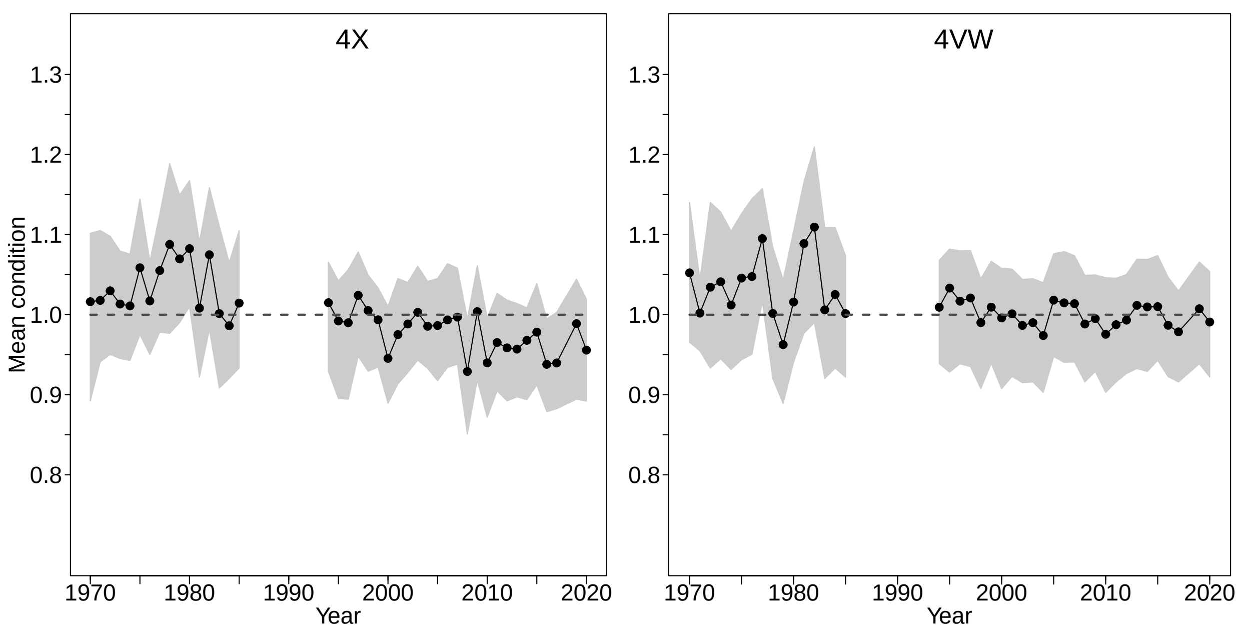
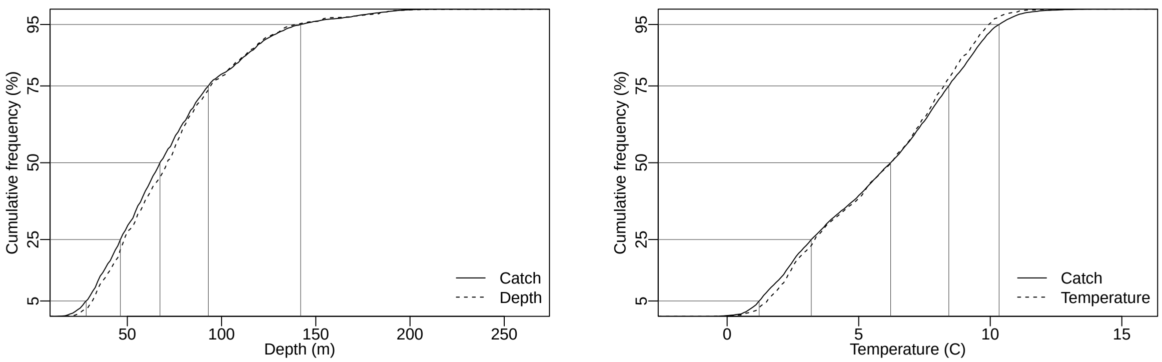
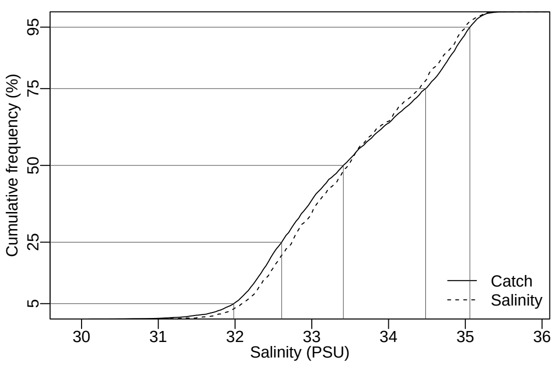



Figure 6.10D. Average fish condition in NAFO units 4X and 4VW for Witch flounder.




| Frequency | Depth | Temperature | Salinity |
|---|---|---|---|
| 0.05 | 30 | 1.5 | 32.08 |
| 0.25 | 48 | 3.3 | 32.73 |
| 0.50 | 70 | 6.2 | 33.45 |
| 0.75 | 93 | 8.2 | 34.40 |
| 0.95 | 138 | 9.9 | 34.99 |

Figure 6.10E. Catch distribution by depth, temperature and salinity of Witch flounder.

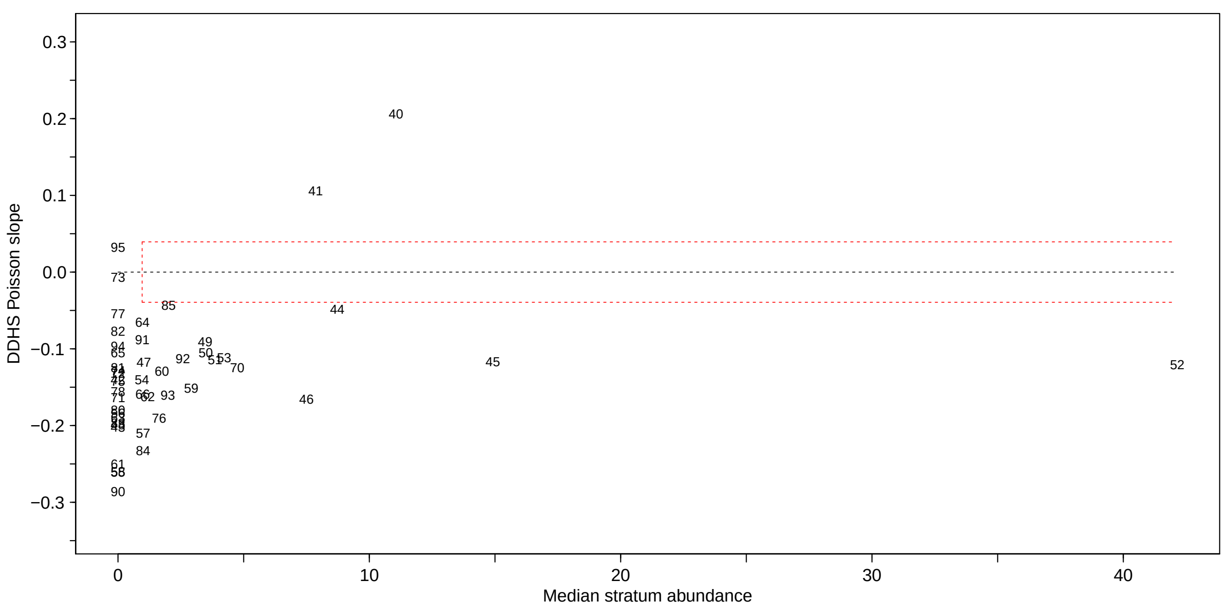



Figure 6.10F. DDHS slopes versus median stratum abundance for Witch flounder. The last two digits of each stratum number is shown in the figure. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance.

## 6.11 Yellowtail flounder (Limande à queue jaune) - species code 42 (category LF)

Scientific name: [Limanda ferruginea]

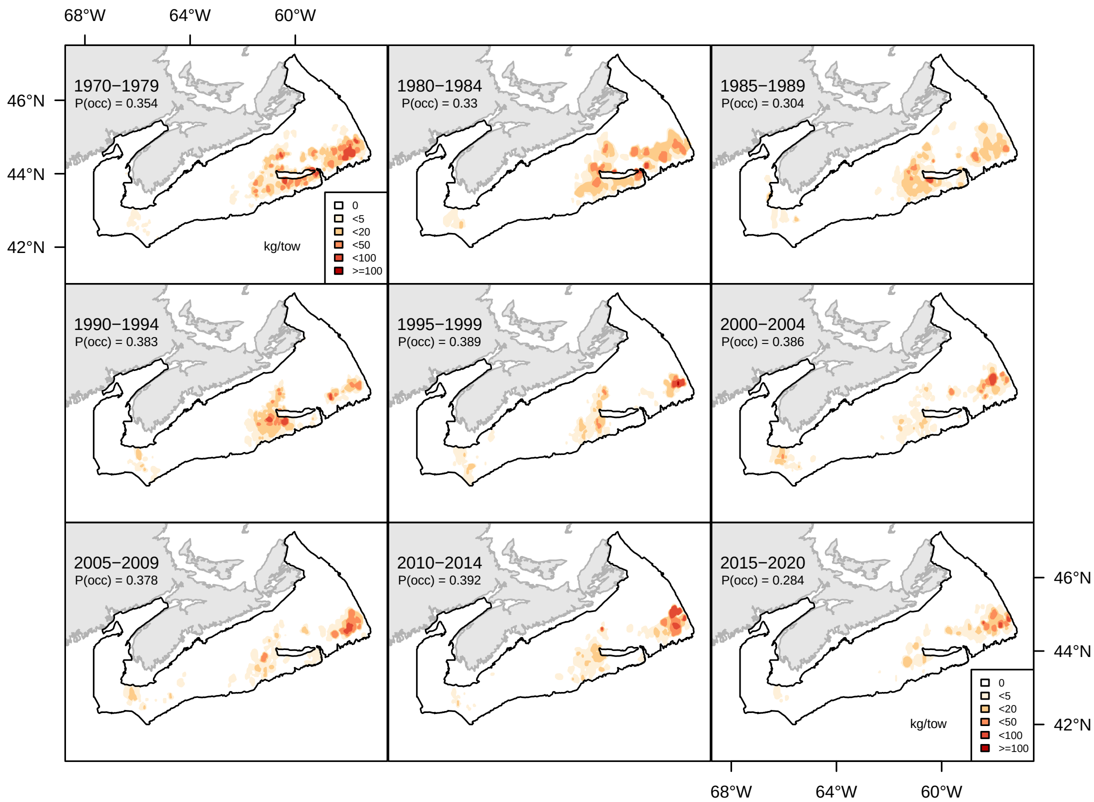



Figure 6.11A. Inverse distance weighted distribution of catch biomass (kg/tow) for Yellowtail flounder. $P(occ)$ is the proportion of tows with catch records for each 5-year period.

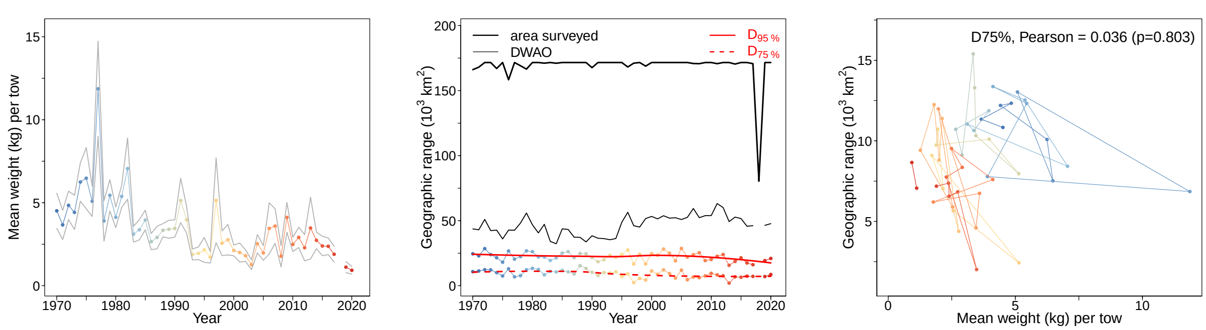



Figure 6.11B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Yellowtail flounder. The predictions from a loess estimator are overlaid on the distribution indices in the middle panel.

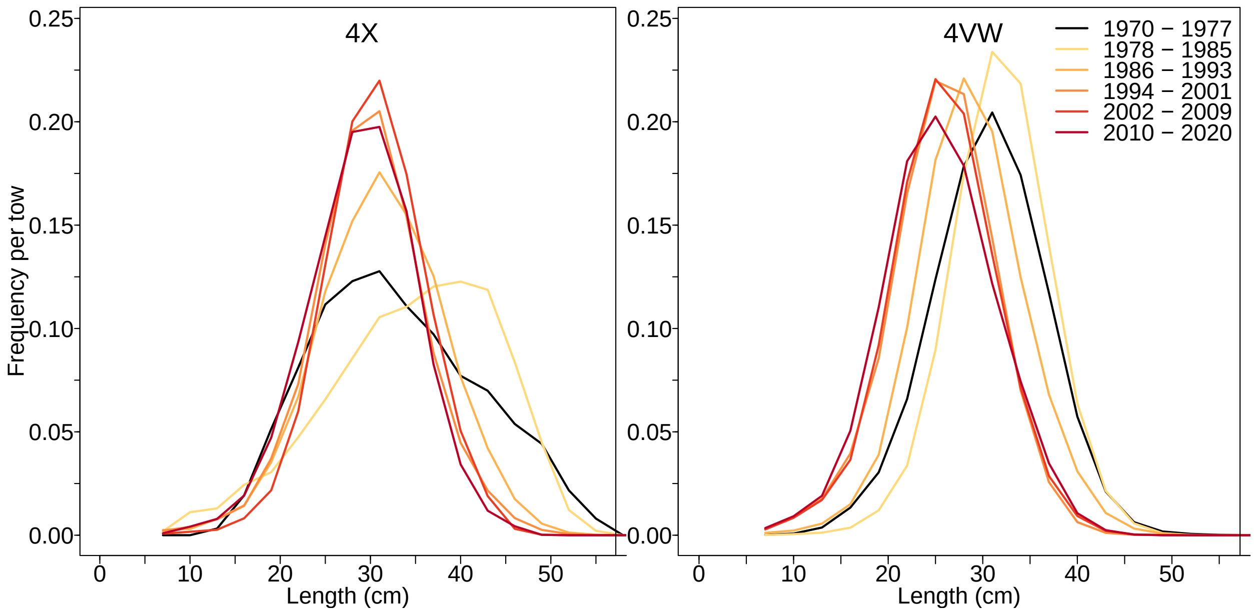



Figure 6.11C. Length frequency distribution in NAFO units 4X and 4VW for Yellowtail flounder.

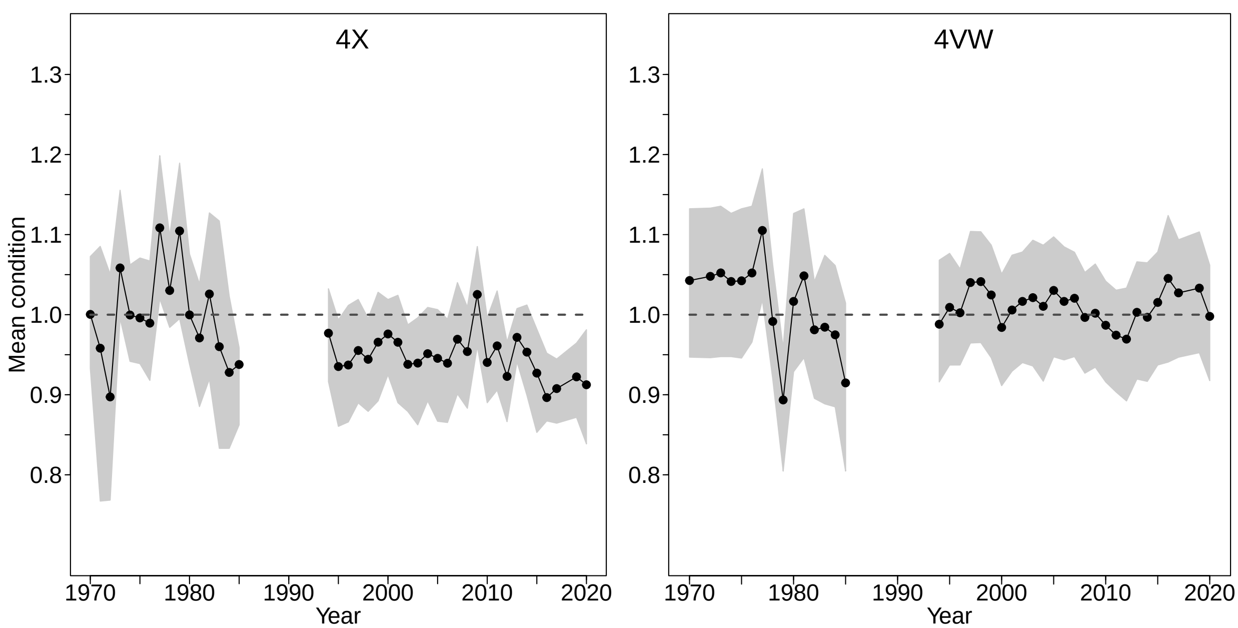
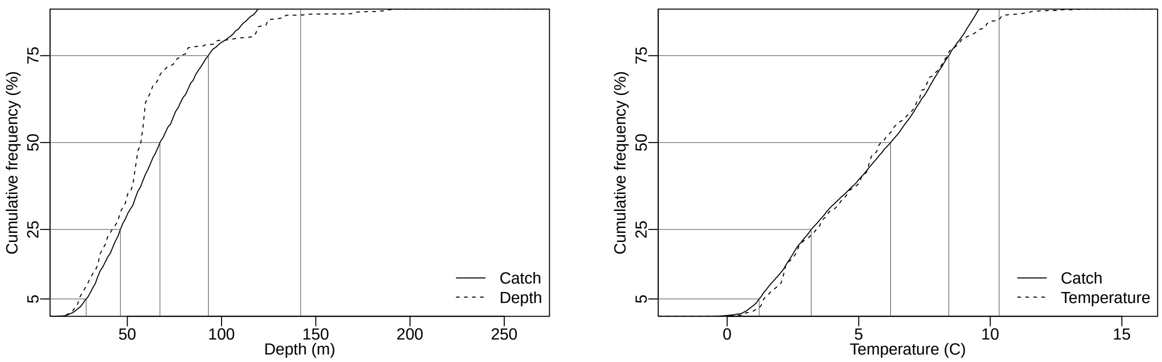
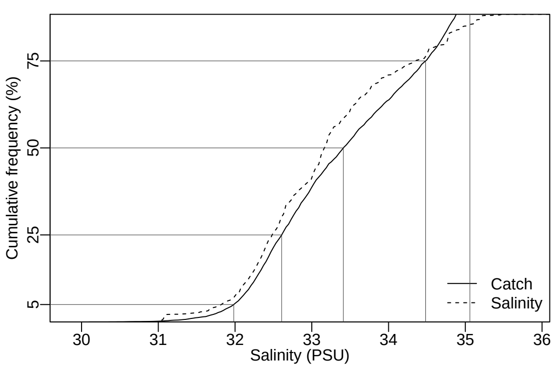



Figure 6.11D. Average fish condition in NAFO units 4X and 4VW for Yellowtail flounder.




| Frequency | Depth | Temperature | Salinity |
|---|---|---|---|
| 0.05 | 24 | 1.4 | 31.81 |
| 0.25 | 41 | 3.3 | 32.47 |
| 0.50 | 57 | 5.8 | 33.16 |
| 0.75 | 78 | 8.3 | 34.33 |
| 0.95 | 274 | 16.4 | 36.10 |

Figure 6.11E. Catch distribution by depth, temperature and salinity of Yellowtail flounder.

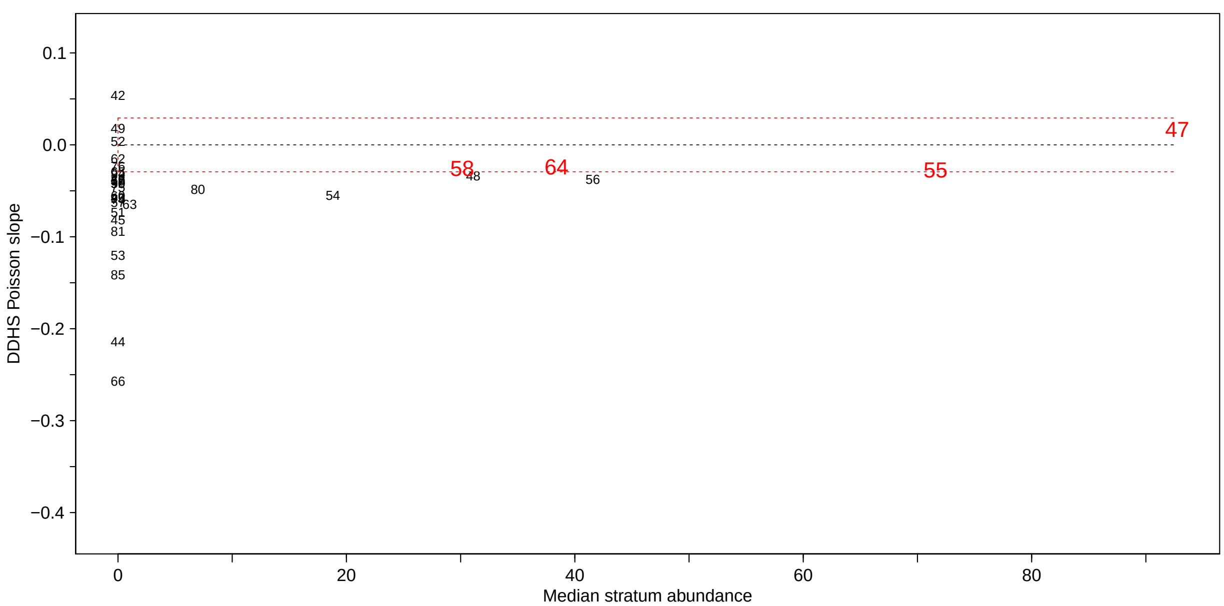



Figure 6.11F. DDHS slopes versus median stratum abundance for Yellowtail flounder. The last two digits of each stratum number is shown in the figure. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance.

## 6.12 Winter flounder (Limande-plie rouge) - species code 43 (category LF)

Scientific name: Pseudopleuronectes americanus

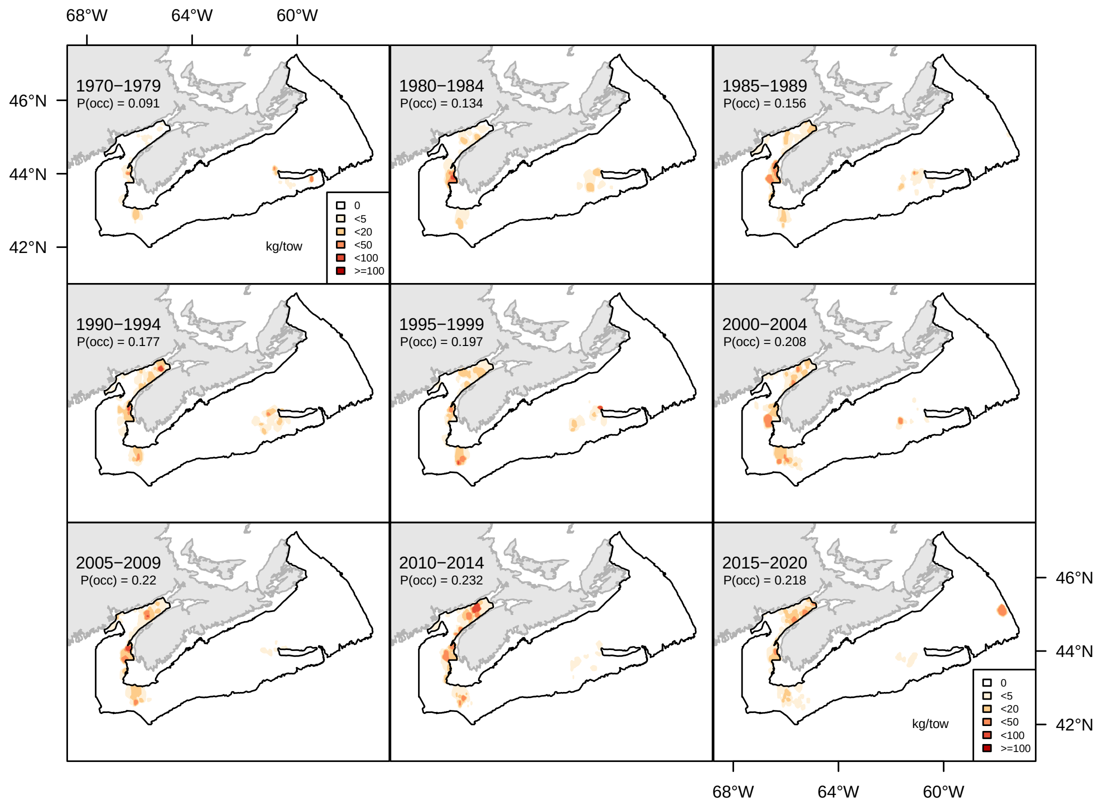



Figure 6.12A. Inverse distance weighted distribution of catch biomass (kg/tow) for Winter flounder. $P(occ)$ is the proportion of tows with catch records for each 5-year period.

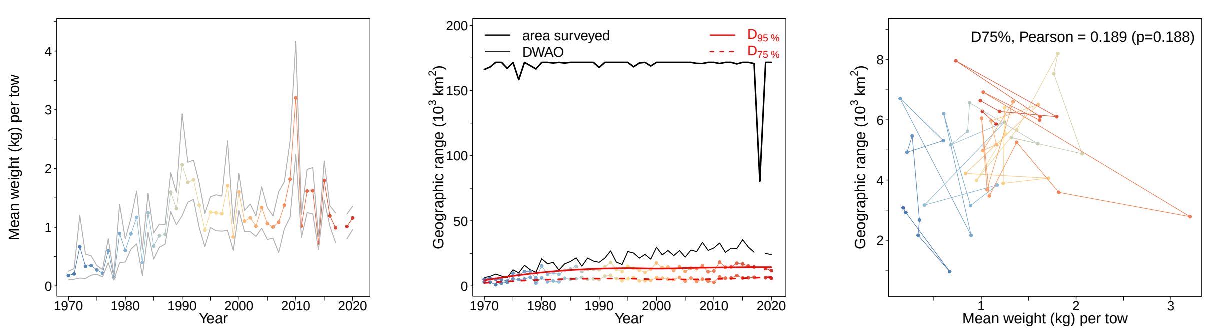



Figure 6.12B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Winter flounder. The predictions from a loess estimator are overlaid on the distribution indices in the middle panel.

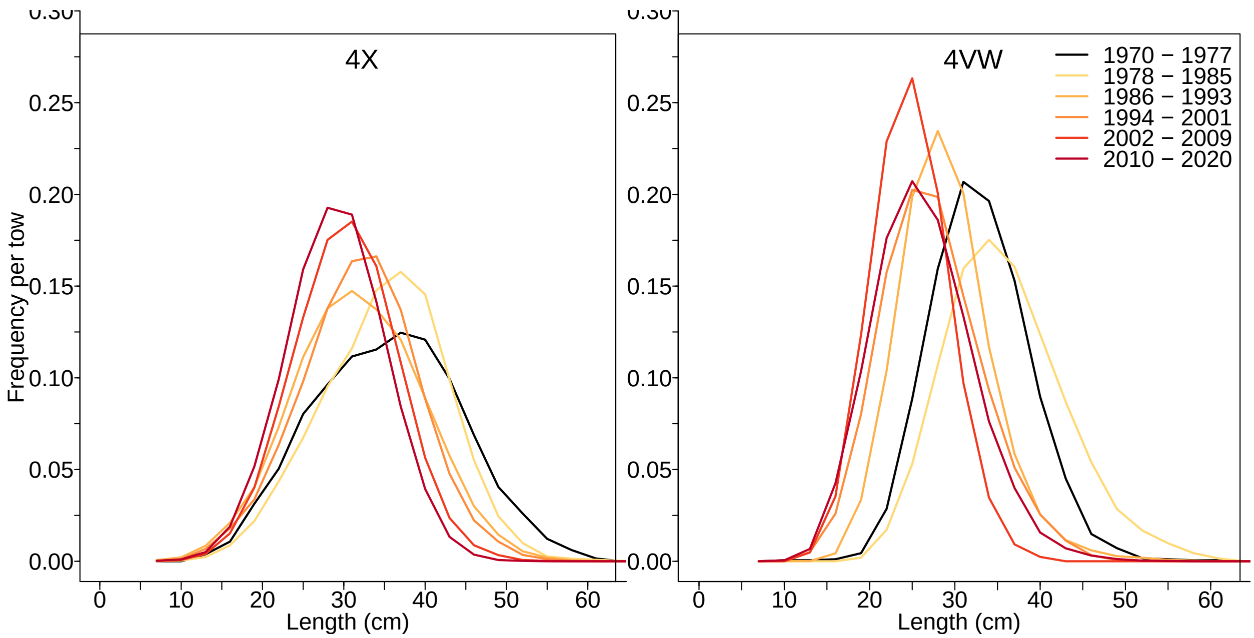



Figure 6.12C. Length frequency distribution in NAFO units 4X and 4VW for Winter flounder.

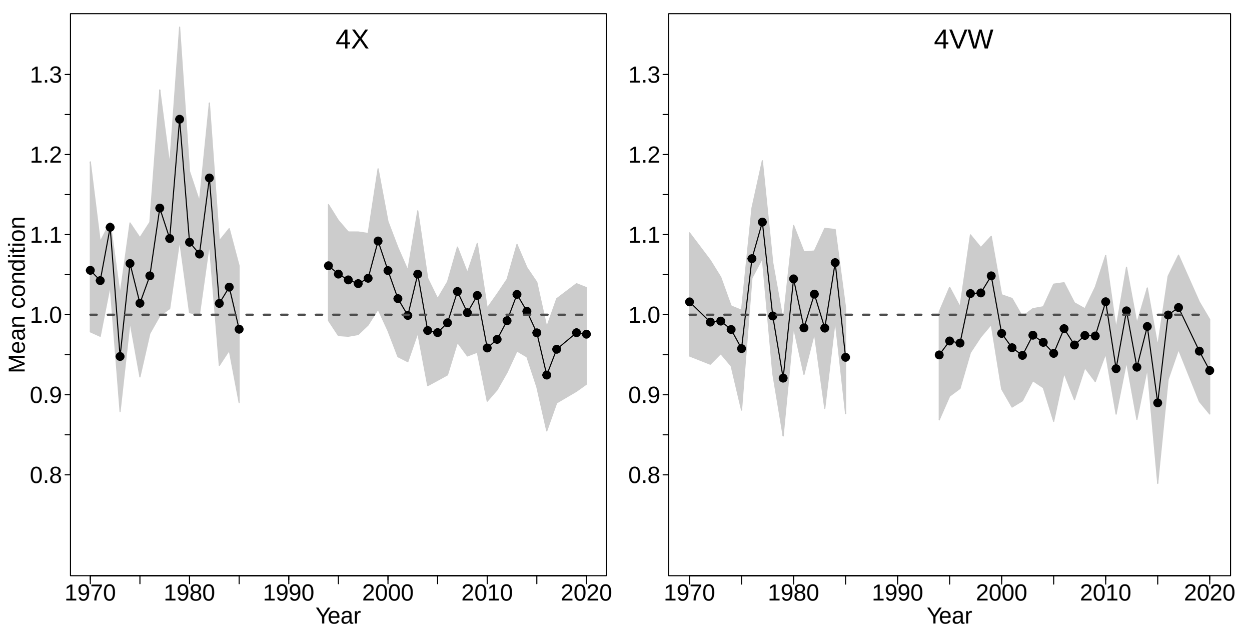
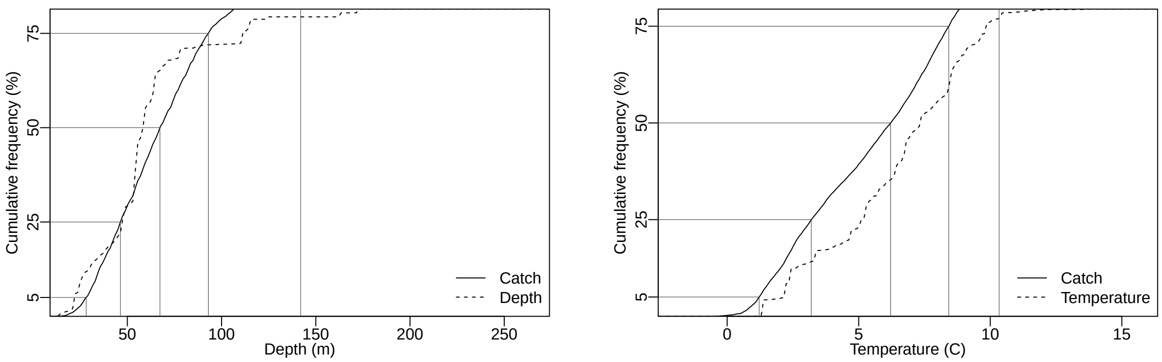
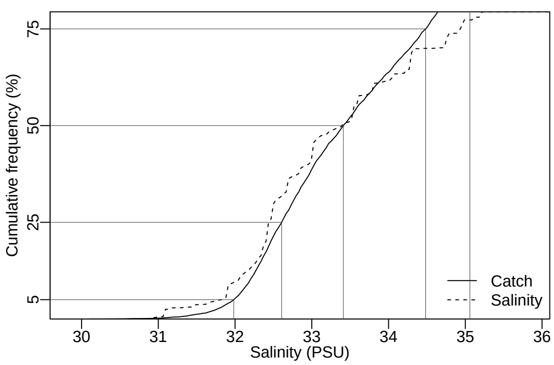



Figure 6.12D. Average fish condition in NAFO units 4X and 4VW for Winter flounder.




| Frequency | Depth | Temperature | Salinity |
|---|---|---|---|
| 0.05 | 21 | 2.1 | 31.81 |
| 0.25 | 46 | 5.0 | 32.44 |
| 0.50 | 58 | 7.3 | 33.38 |
| 0.75 | 110 | 9.8 | 34.92 |
| 0.95 | 274 | 16.4 | 36.10 |

Figure 6.12E. Catch distribution by depth, temperature and salinity of Winter flounder.

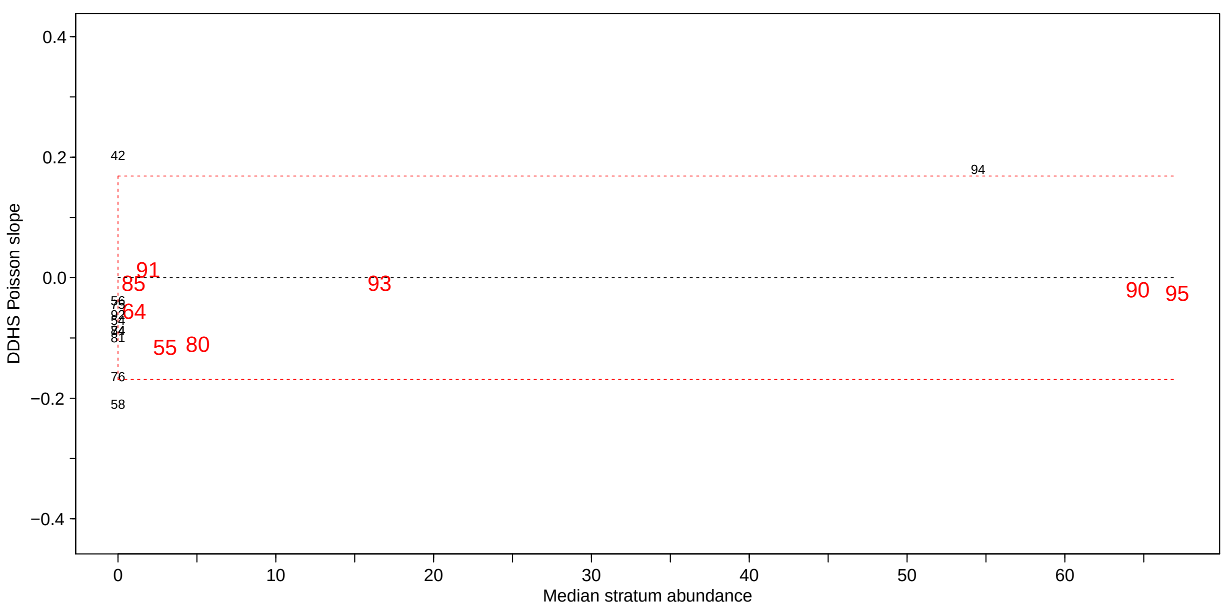



Figure 6.12F. DDHS slopes versus median stratum abundance for Winter flounder. The last two digits of each stratum number is shown in the figure. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance.

### 6.13 Atlantic redfishes (Sébastes de l'Atlantique) - species code 23 (category LF)

Scientific name: Sebastes

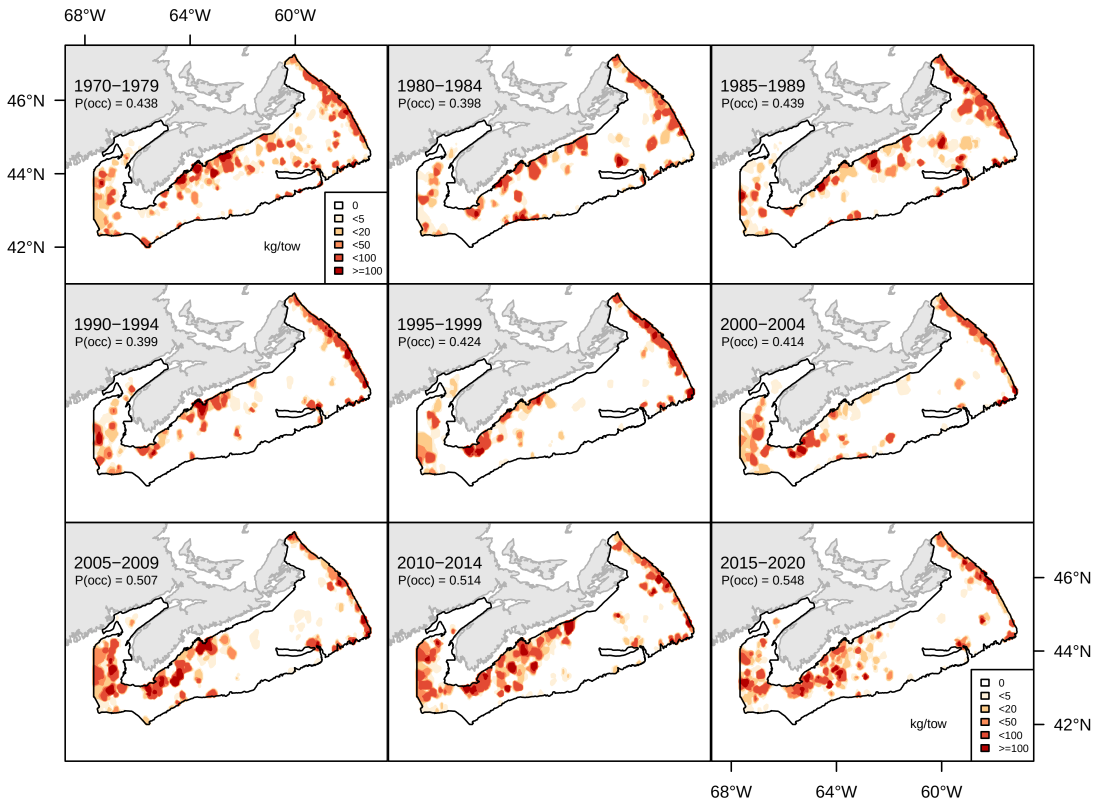



Figure 6.13A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic redfishes. $P(occ)$ is the proportion of tows with catch records for each 5-year period.

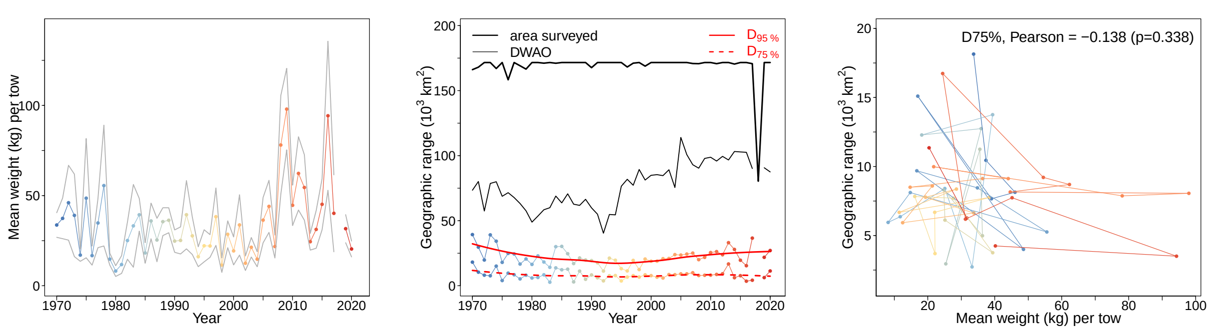



Figure 6.13B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic redfishes. The predictions from a loess estimator are overlaid on the distribution indices in the middle panel.

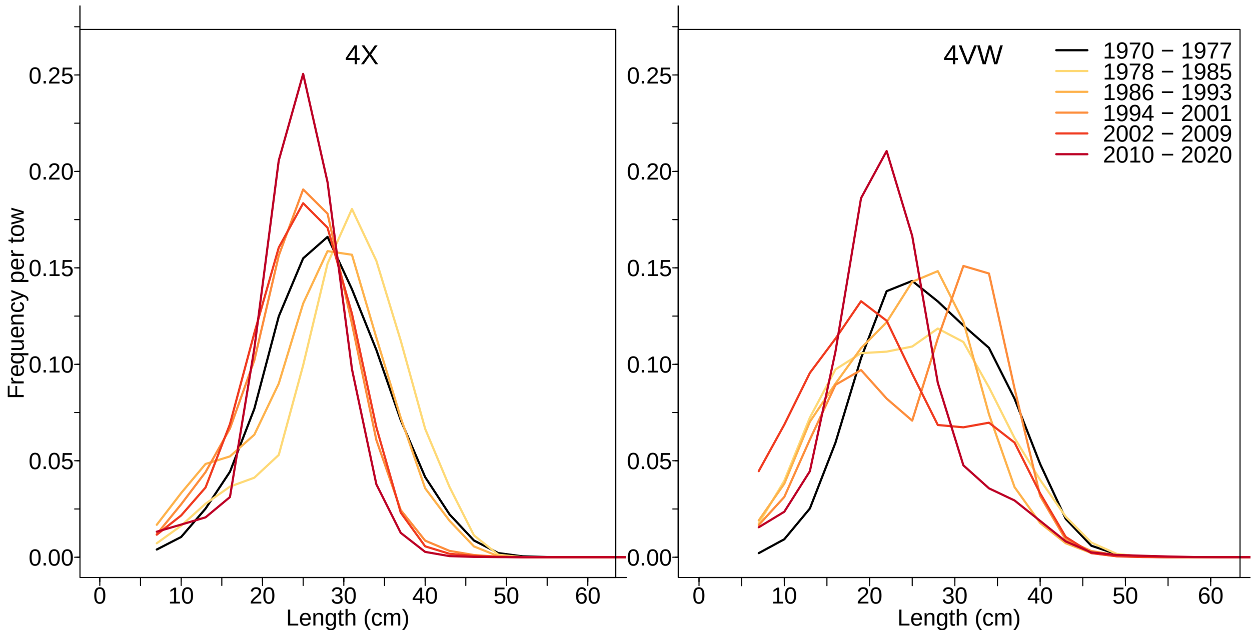



Figure 6.13C. Length frequency distribution in NAFO units 4X and 4VW for Atlantic redfishes.

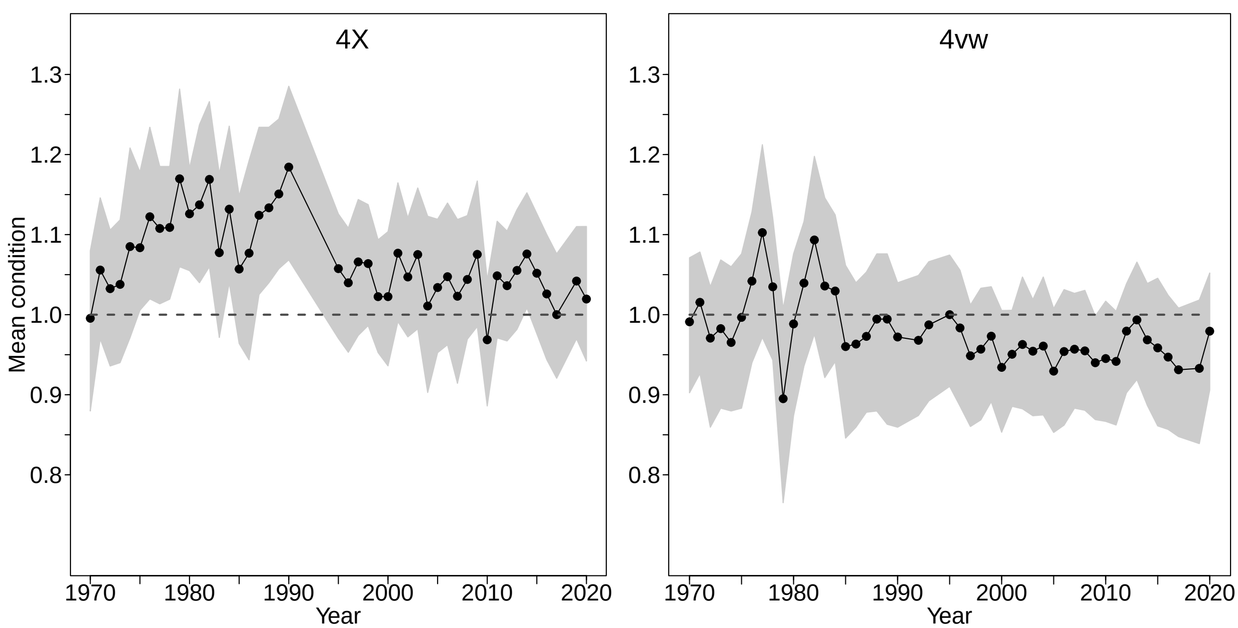
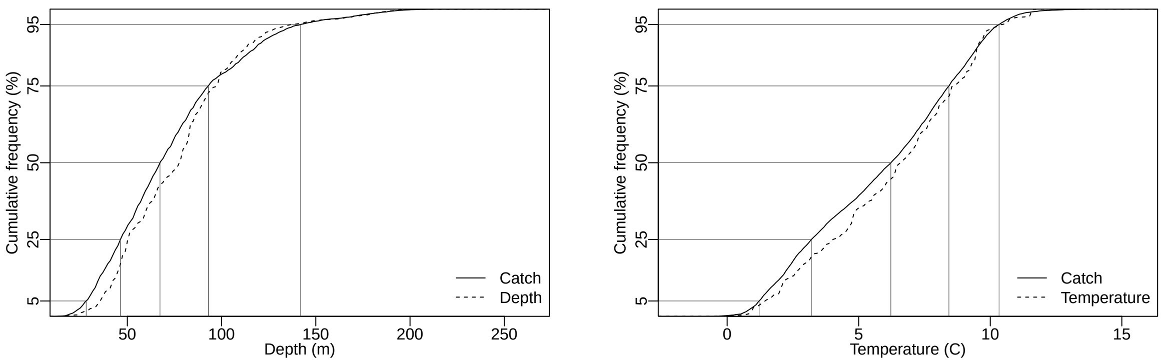
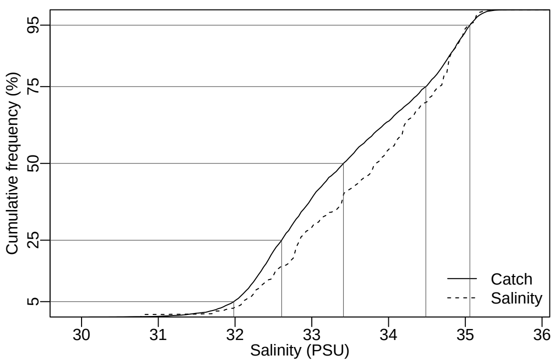



Figure 6.13D. Average fish condition in NAFO units 4X and 4VW for Atlantic redfishes.




| Frequency | Depth | Temperature | Salinity |
|---|---|---|---|
| 0.05 | 34 | 1.4 | 32.08 |
| 0.25 | 49 | 4.0 | 32.83 |
| 0.50 | 77 | 6.5 | 33.81 |
| 0.75 | 97 | 8.5 | 34.66 |
| 0.95 | 137 | 10.4 | 35.02 |

Figure 6.13E. Catch distribution by depth, temperature and salinity of Atlantic redfishes.

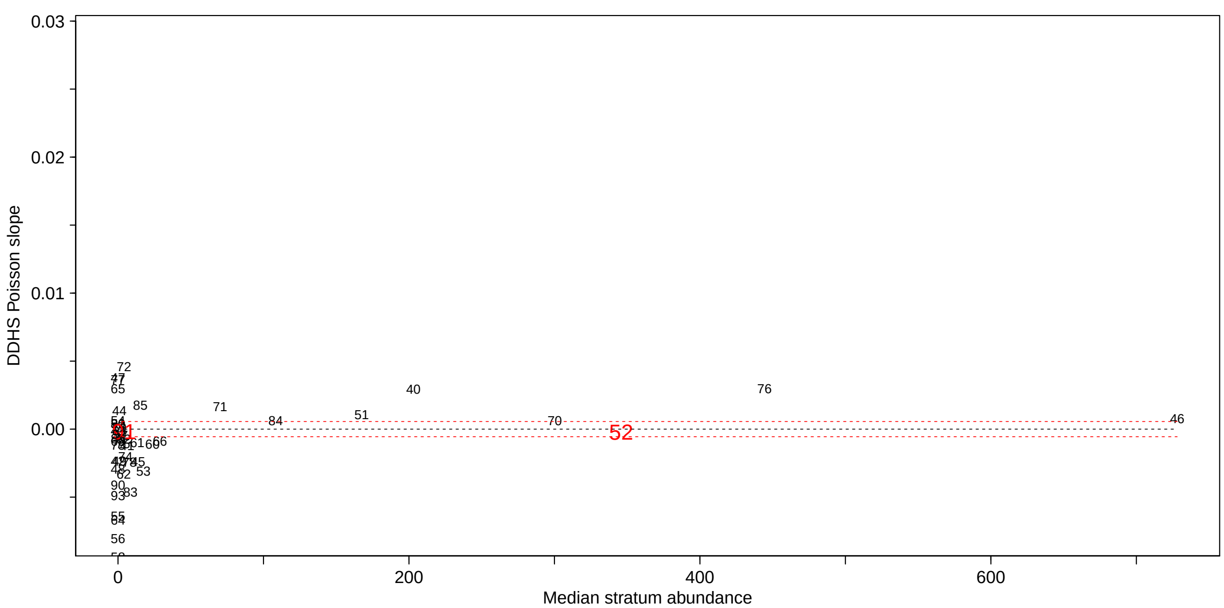



Figure 6.13F. DDHS slopes versus median stratum abundance for Atlantic redfishes. The last two digits of each stratum number is shown in the figure. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance.

## 6.14 Atlantic wolffish (Loup atlantique) - species code 50 (category LF)

Scientific name: [Anarhichas lupus]

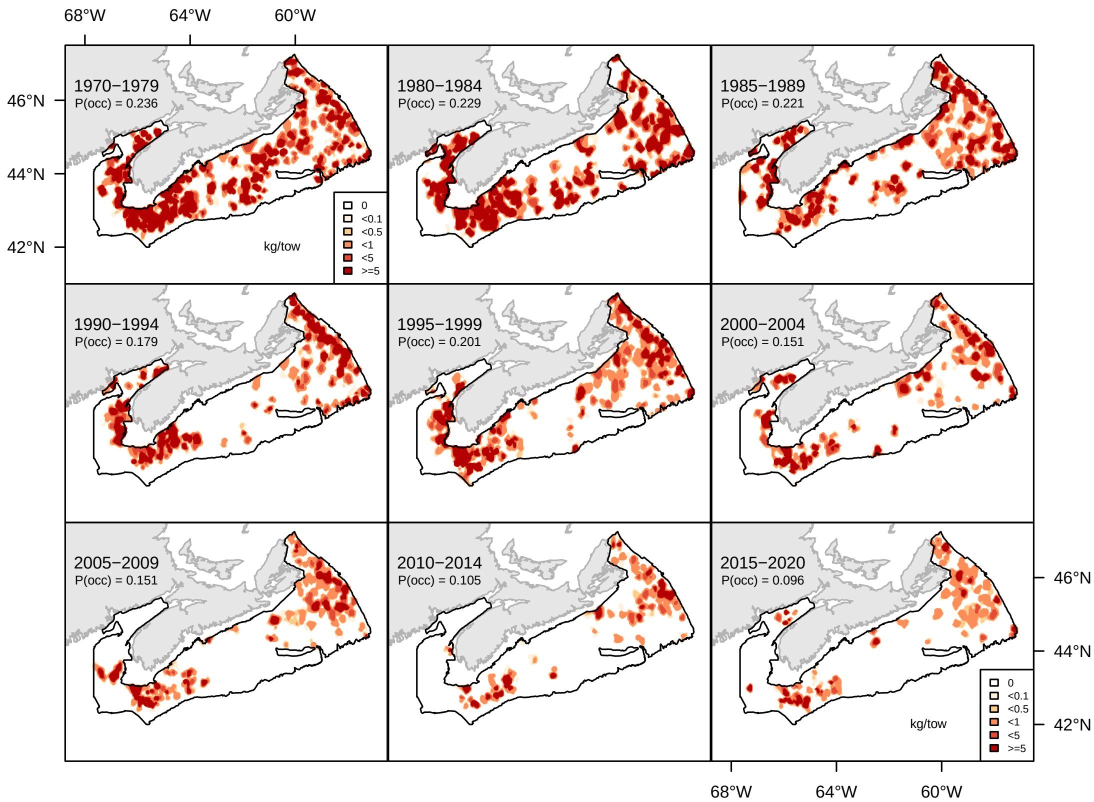



Figure 6.14A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic wolffish. $P(occ)$ is the proportion of tows with catch records for each 5-year period.

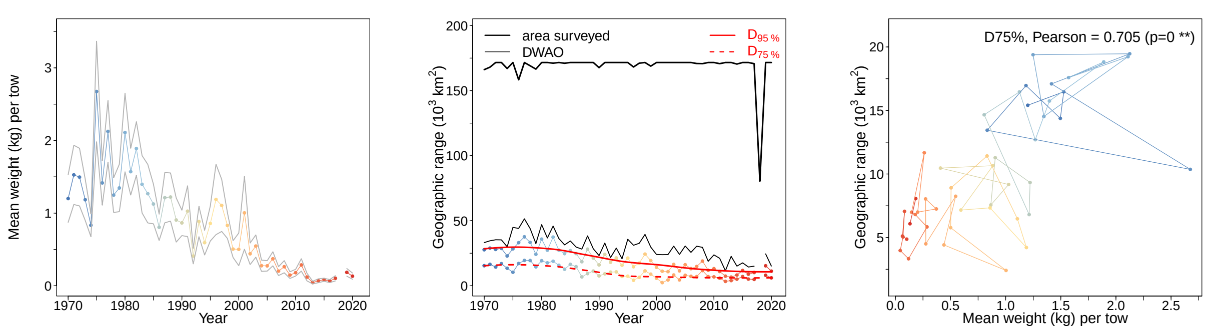



Figure 6.14B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic wolffish. The predictions from a loess estimator are overlaid on the distribution indices in the middle panel.

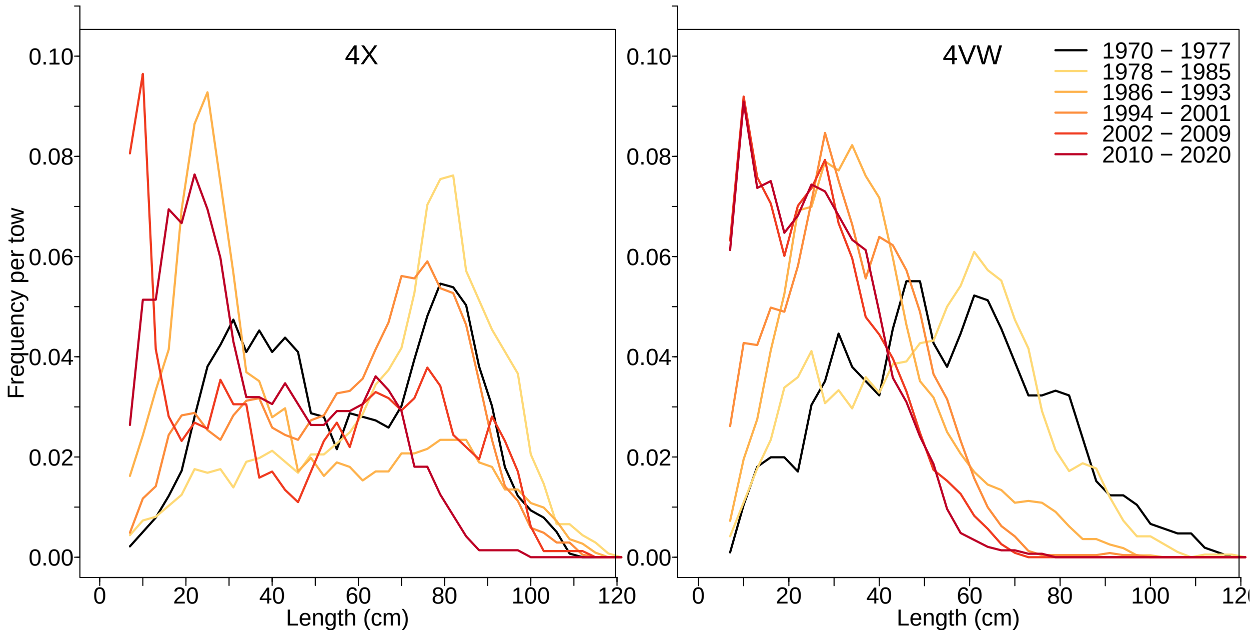



Figure 6.14C. Length frequency distribution in NAFO units 4X and 4VW for Atlantic wolffish.

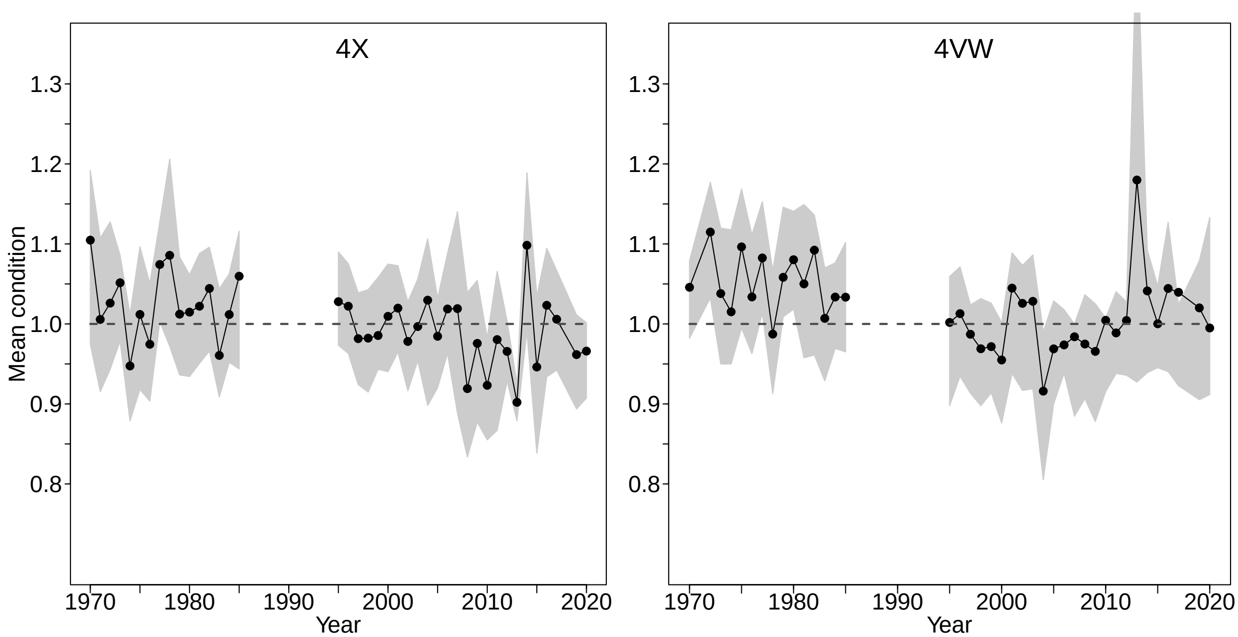
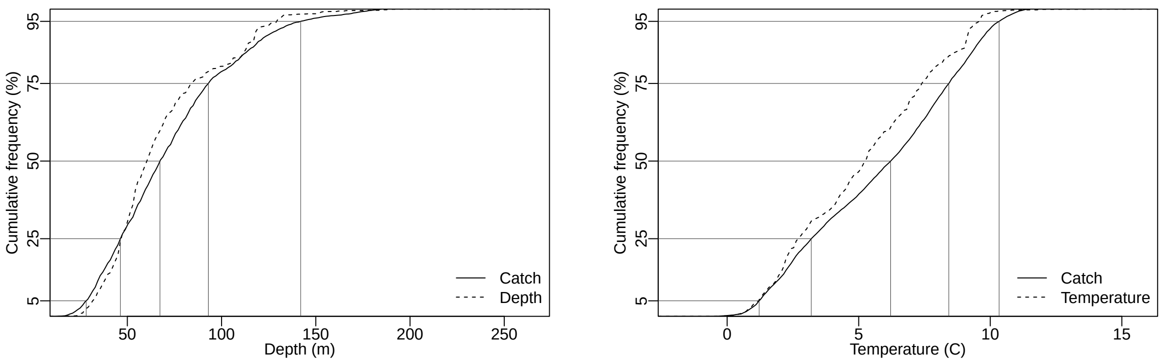
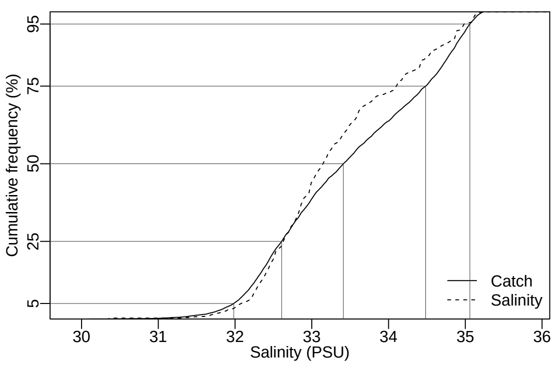



Figure 6.14D. Average fish condition in NAFO units 4X and 4VW for Atlantic wolffish.




| Frequency | Depth | Temperature | Salinity |
|---|---|---|---|
| 0.05 | 30 | 1.1 | 32.08 |
| 0.25 | 46 | 2.6 | 32.60 |
| 0.50 | 60 | 5.2 | 33.12 |
| 0.75 | 84 | 7.4 | 34.07 |
| 0.95 | 129 | 9.5 | 34.96 |

Figure 6.14E. Catch distribution by depth, temperature and salinity of Atlantic wolffish.

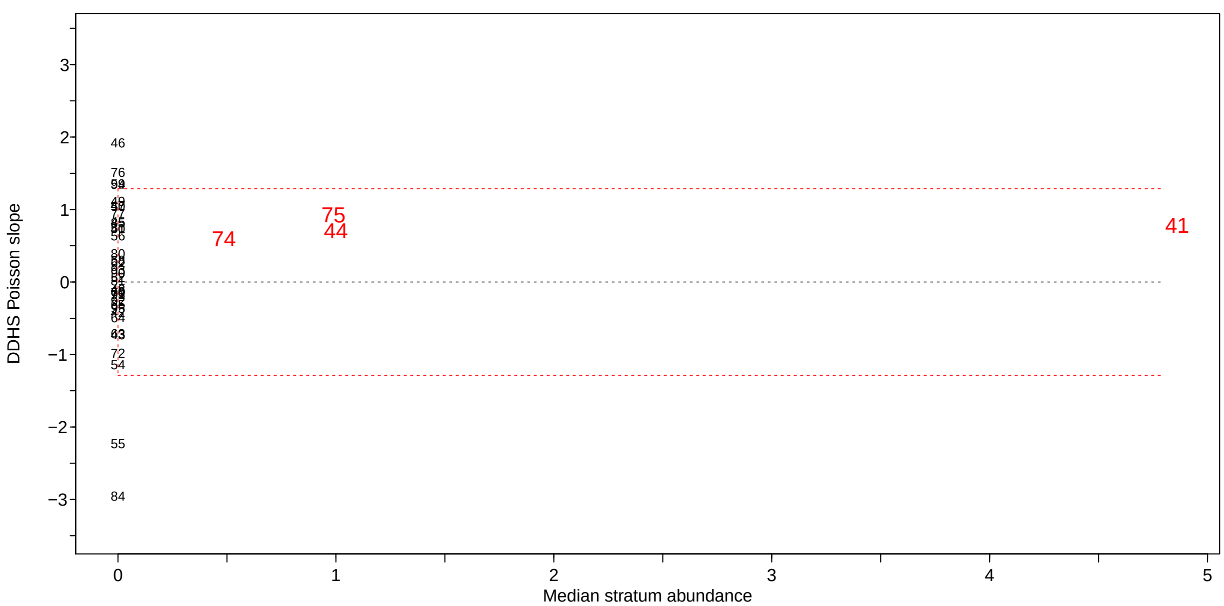



Figure 6.14F. DDHS slopes versus median stratum abundance for Atlantic wolffish. The last two digits of each stratum number is shown in the figure. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance.

## 6.15 Longhorn sculpin (Chaboisseau à 18 épines) - species code 300 (category LF)

Scientific name: Myoxocephalus octodecemspinosus

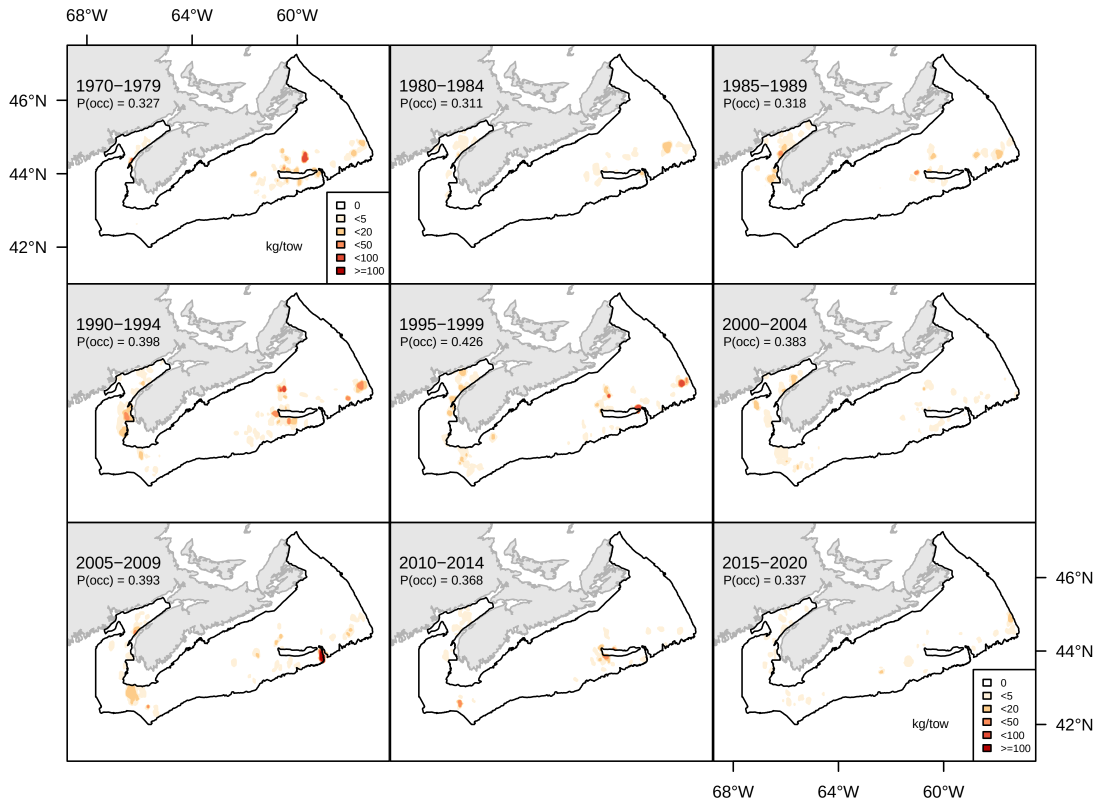



Figure 6.15A. Inverse distance weighted distribution of catch biomass (kg/tow) for Longhorn sculpin. $P(occ)$ is the proportion of tows with catch records for each 5-year period.

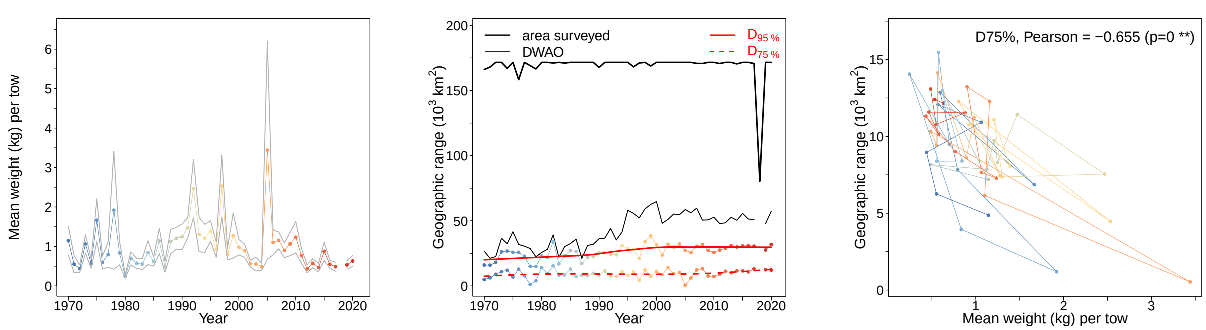



Figure 6.15B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Longhorn sculpin. The predictions from a loess estimator are overlaid on the distribution indices in the middle panel.

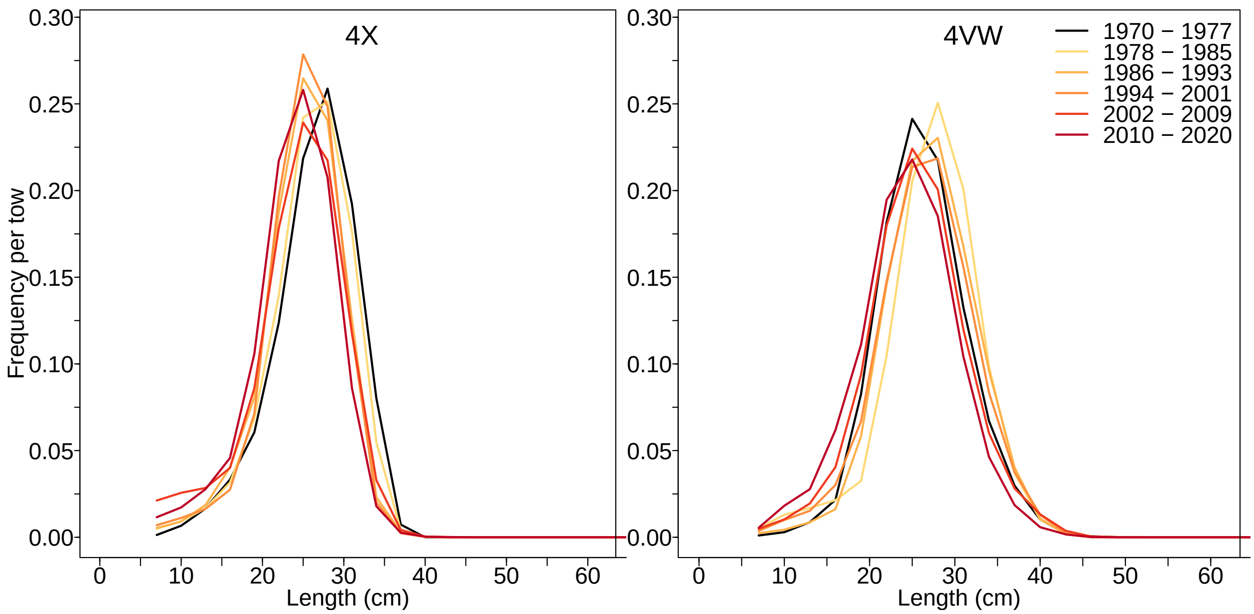



Figure 6.15C. Length frequency distribution in NAFO units 4X and 4VW for Longhorn sculpin.

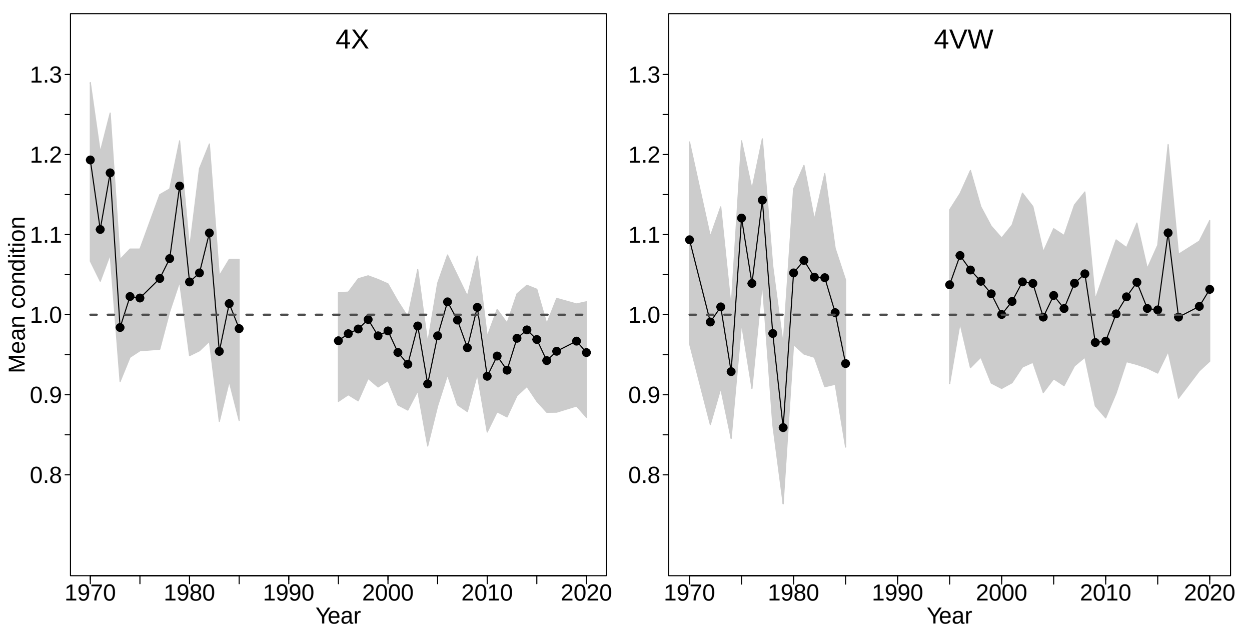
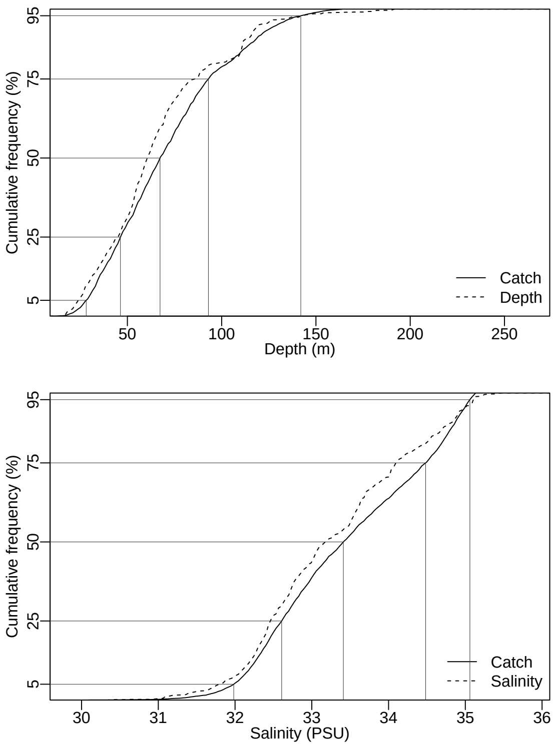



Figure 6.15D. Average fish condition in NAFO units 4X and 4VW for Longhorn sculpin.




| Frequency | Depth | Temperature | Salinity |
|---|---|---|---|
| 0.05 | 24 | 1.0 | 31.78 |
| 0.25 | 45 | 3.4 | 32.44 |
| 0.50 | 60 | 5.7 | 33.16 |
| 0.75 | 85 | 7.8 | 34.07 |
| 0.95 | 141 | 10.6 | 35.09 |

Figure 6.15E. Catch distribution by depth, temperature and salinity of Longhorn sculpin.

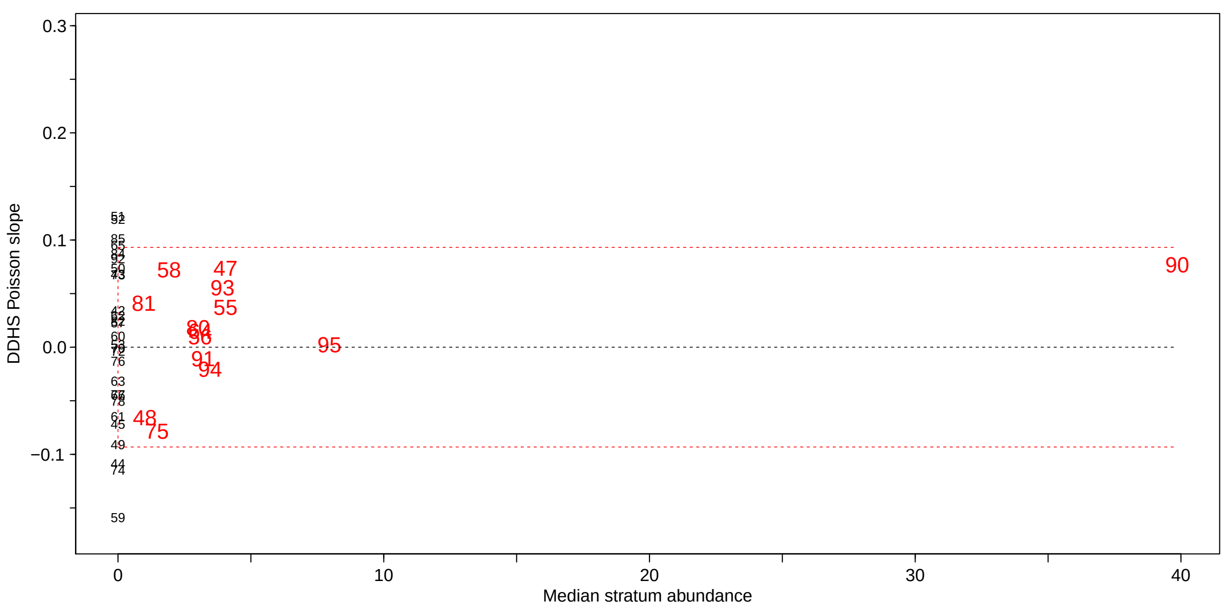



Figure 6.15F. DDHS slopes versus median stratum abundance for Longhorn sculpin. The last two digits of each stratum number is shown in the figure. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance.

## 6.16 Atlantic herring (Hareng de l'Atlantique) - species code 60 (category LF)

Scientific name: [Clupea harengus]

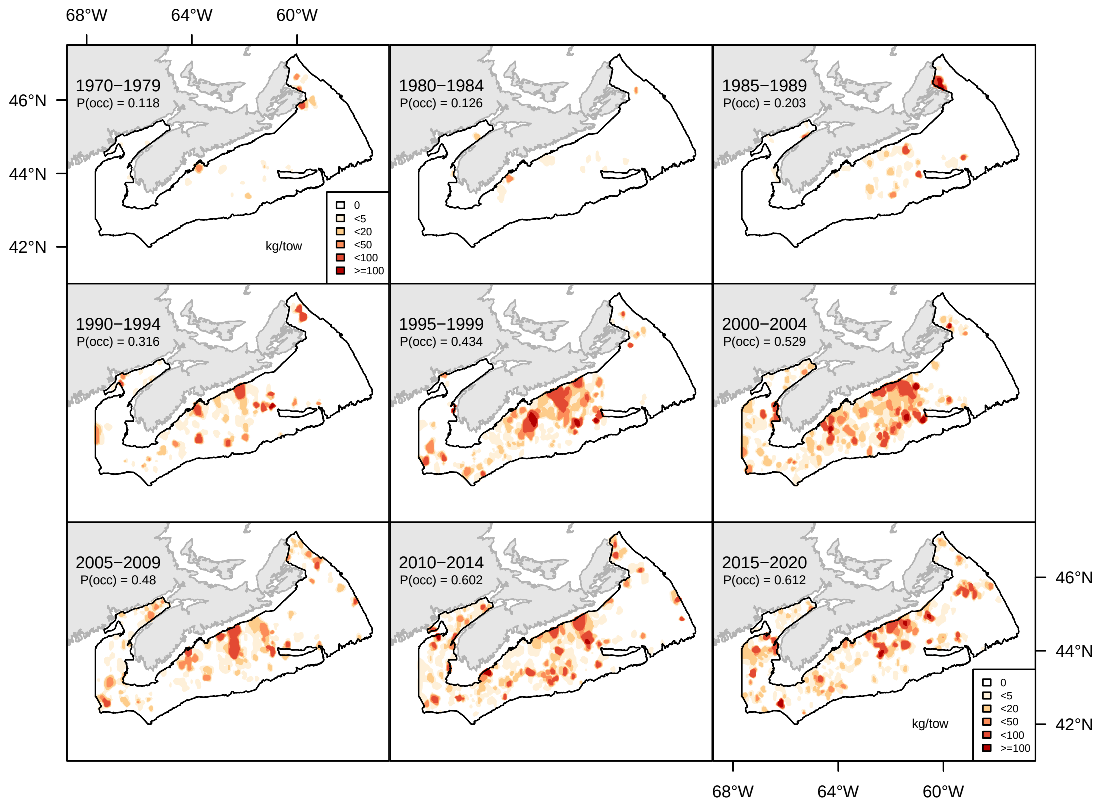



Figure 6.16A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic herring. $P(occ)$ is the proportion of tows with catch records for each 5-year period.

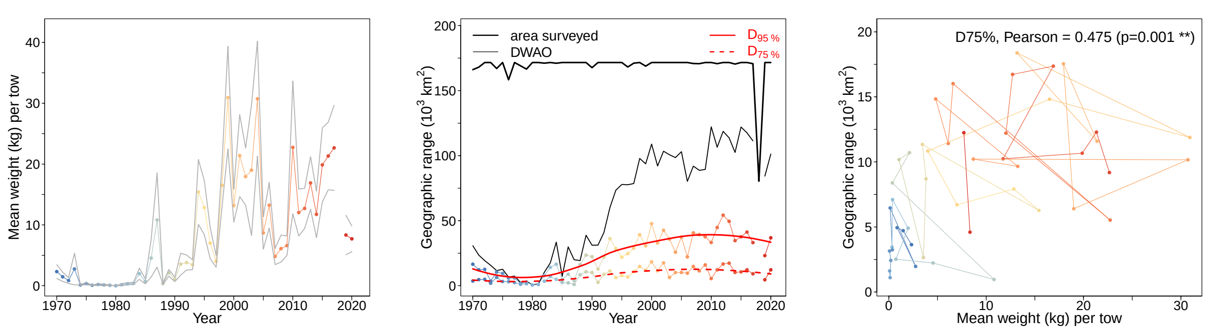



Figure 6.16B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic herring. The predictions from a loess estimator are overlaid on the distribution indices in the middle panel.

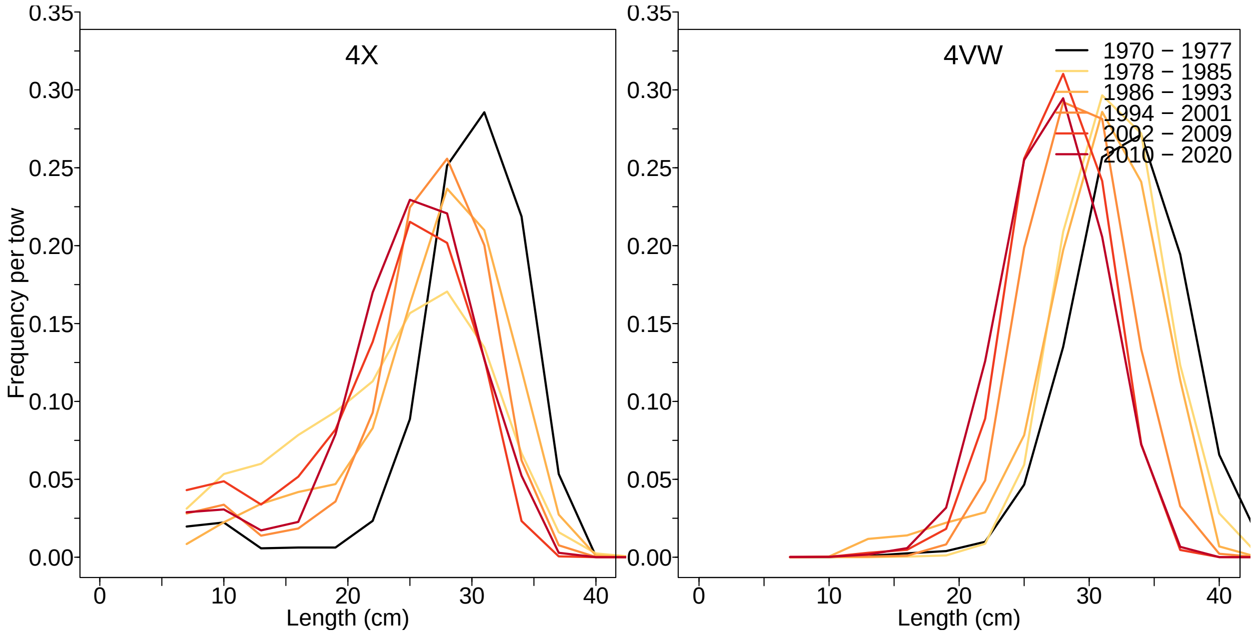



Figure 6.16C. Length frequency distribution in NAFO units 4X and 4VW for Atlantic herring.

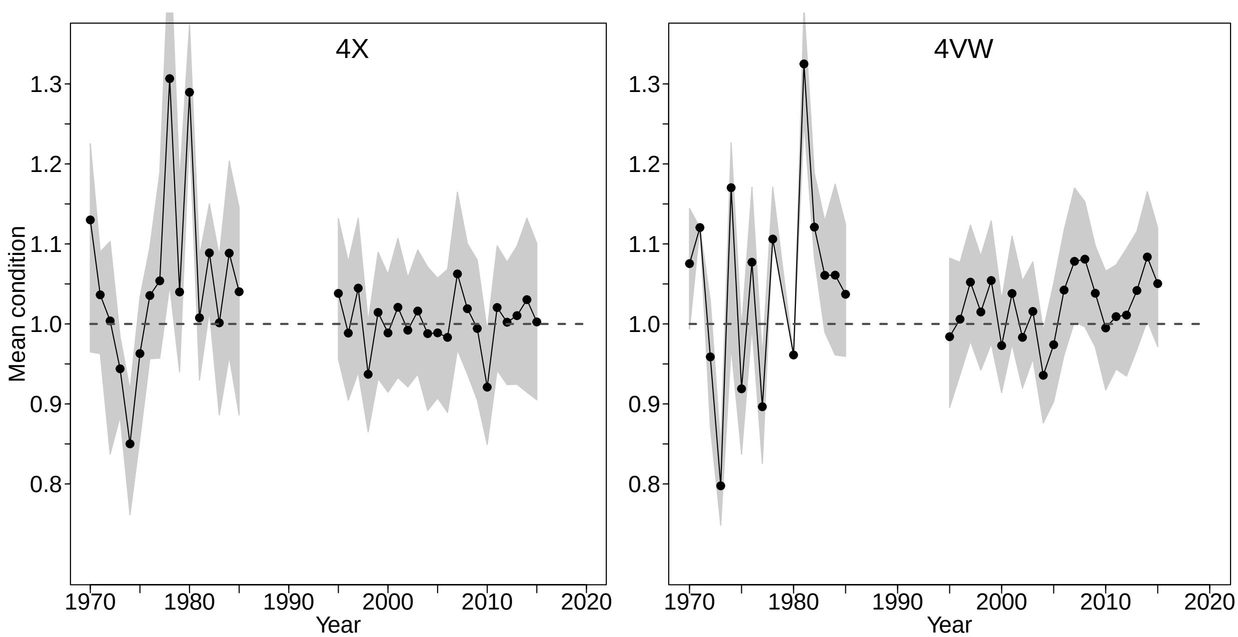
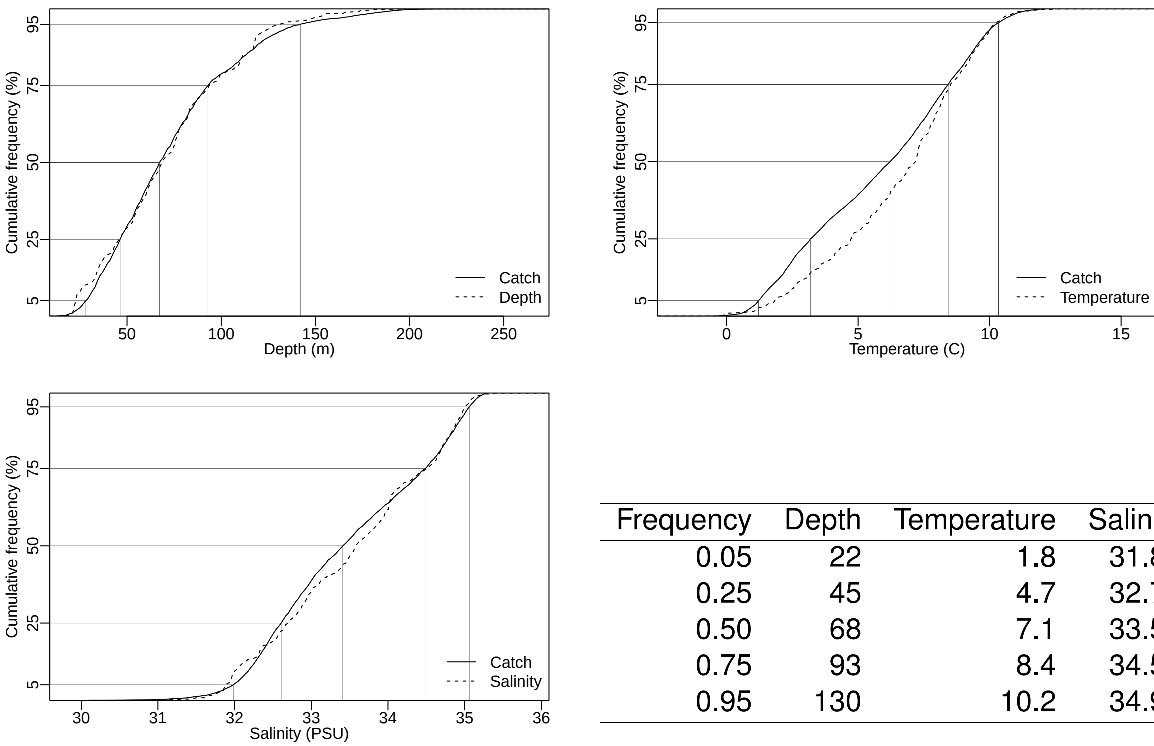



Figure 6.16D. Average fish condition in NAFO units 4X and 4VW for Atlantic herring.




| Frequency | Depth | Temperature | Salinity |
|---|---|---|---|
| 0.05 | 22 | 1.8 | 31.85 |
| 0.25 | 45 | 4.7 | 32.70 |
| 0.50 | 68 | 7.1 | 33.55 |
| 0.75 | 93 | 8.4 | 34.50 |
| 0.95 | 130 | 10.2 | 34.99 |

Figure 6.16E. Catch distribution by depth, temperature and salinity of Atlantic herring.

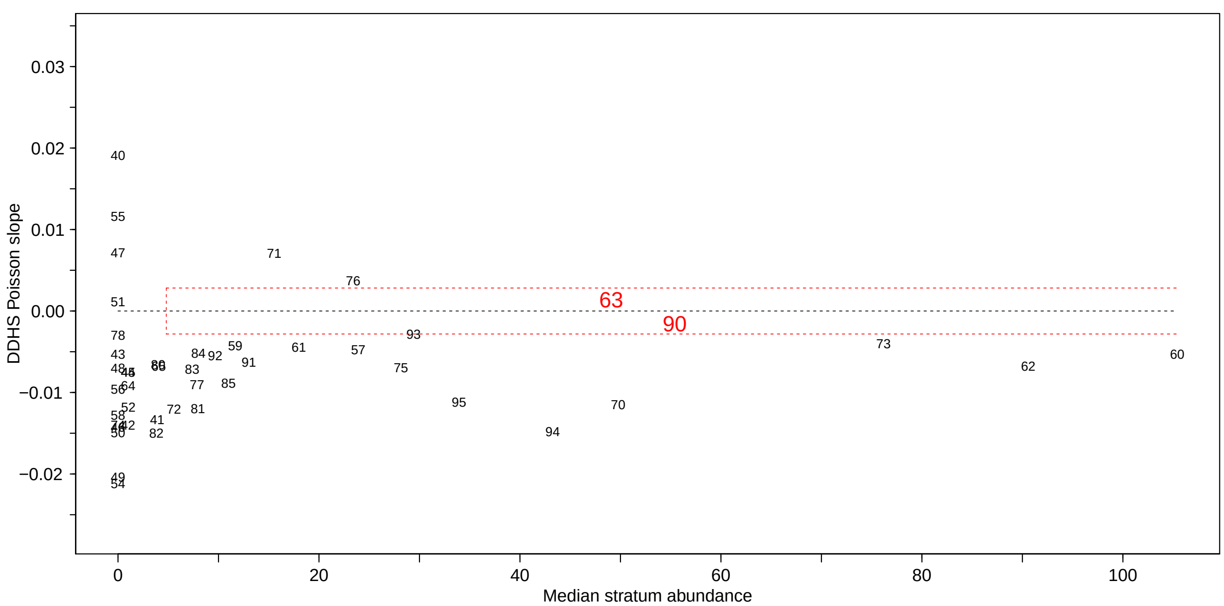



Figure 6.16F. DDHS slopes versus median stratum abundance for Atlantic herring. The last two digits of each stratum number is shown in the figure. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance.

## 6.17 Monkfish (Baudroie d'Amérique) - species code 400 (category LF)

Scientific name: Lophius americanus

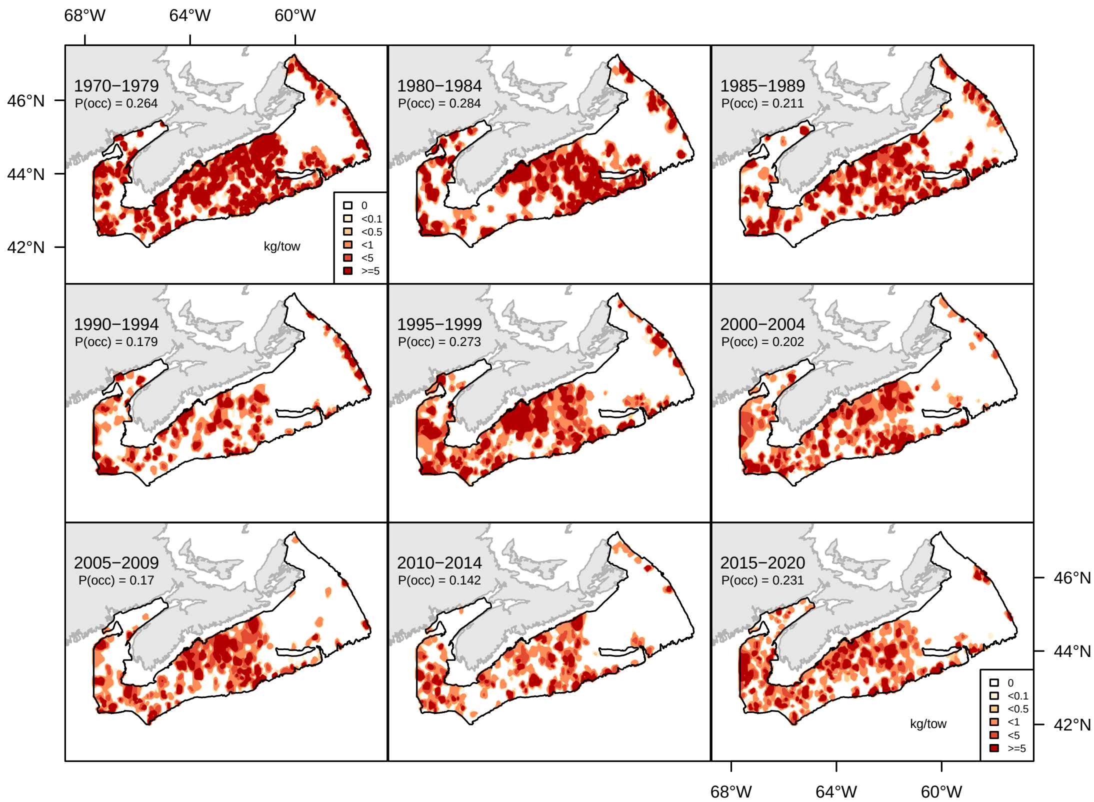



Figure 6.17A. Inverse distance weighted distribution of catch biomass (kg/tow) for Monkfish. $P(occ)$ is the proportion of tows with catch records for each 5-year period.

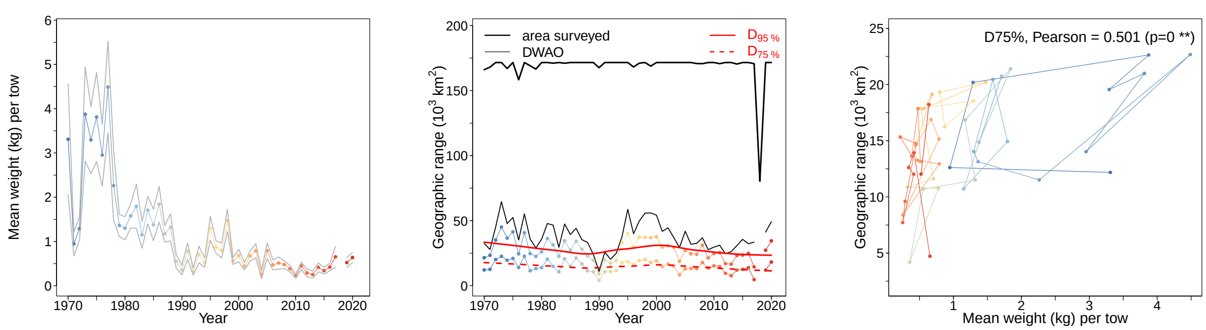



Figure 6.17B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Monkfish. The predictions from a loess estimator are overlaid on the distribution indices in the middle panel.

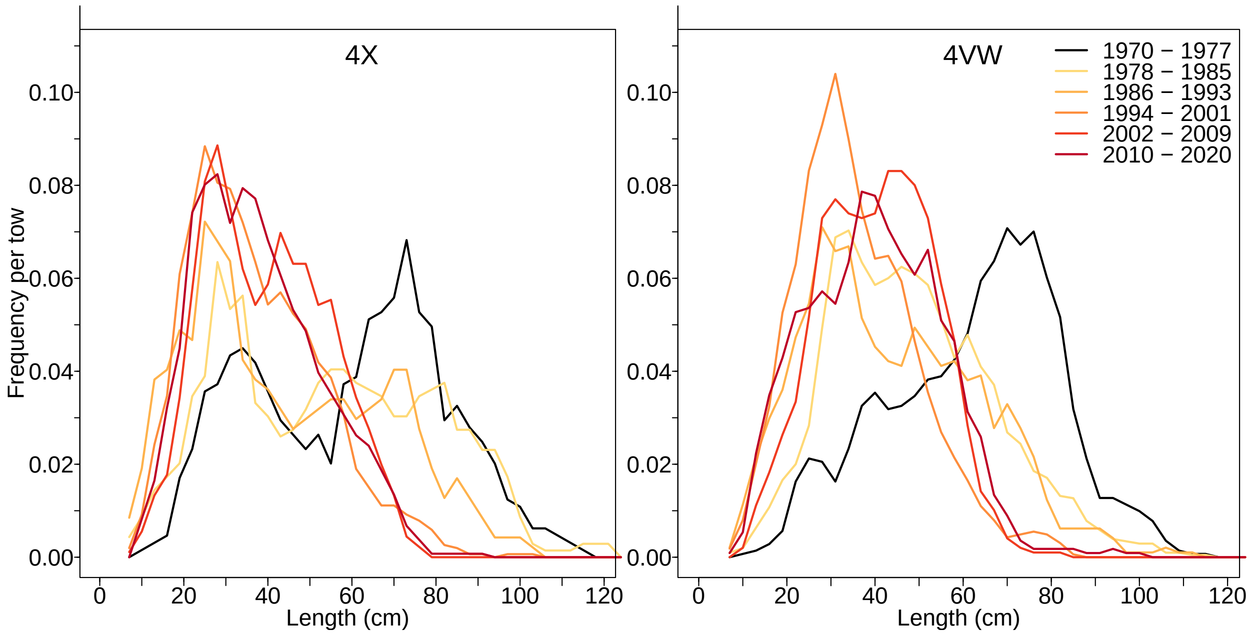



Figure 6.17C. Length frequency distribution in NAFO units 4X and 4VW for Monkfish.

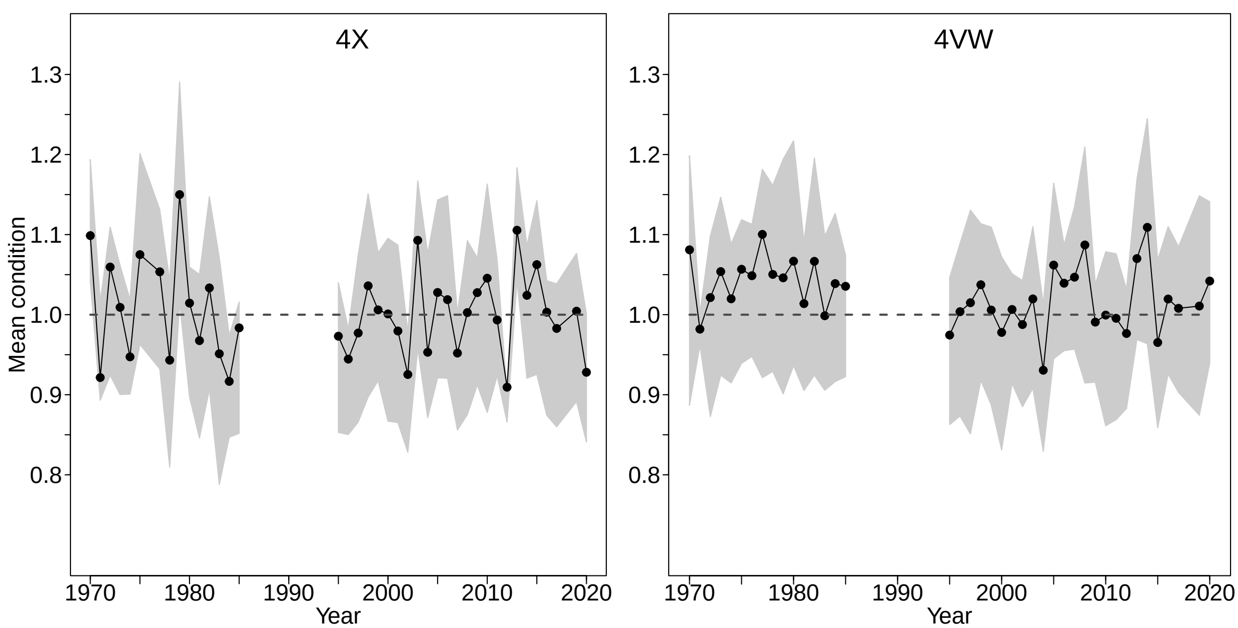
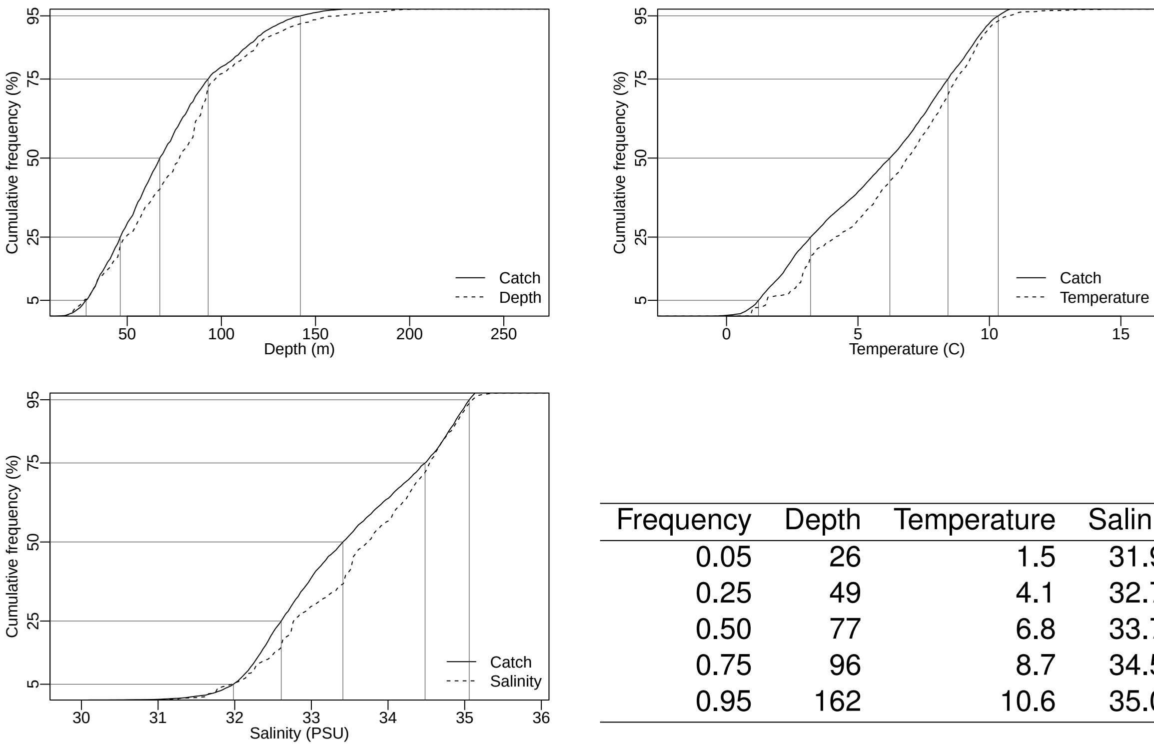



Figure 6.17D. Average fish condition in NAFO units 4X and 4VW for Monkfish.



| Frequency | Depth | Temperature | Salinity |
|---|---|---|---|
| 0.05 | 26 | 1.5 | 31.95 |
| 0.25 | 49 | 4.1 | 32.76 |
| 0.50 | 77 | 6.8 | 33.71 |
| 0.75 | 96 | 8.7 | 34.53 |
| 0.95 | 162 | 10.6 | 35.09 |

Figure 6.17E. Catch distribution by depth, temperature and salinity of Monkfish.

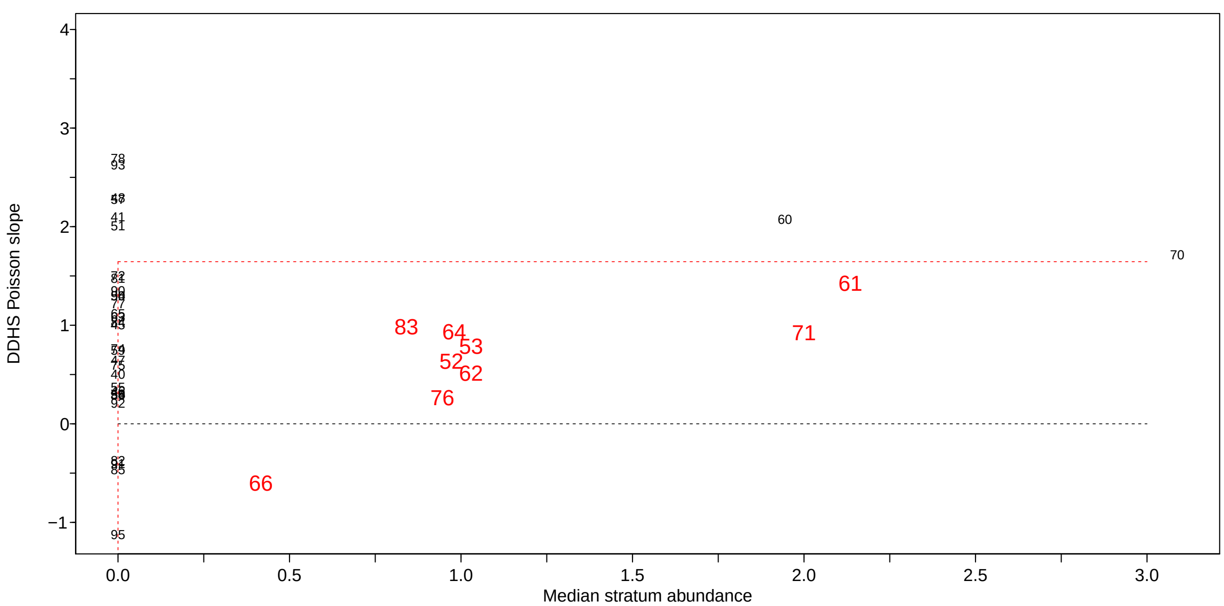


Figure 6.17F. DDHS slopes versus median stratum abundance for Monkfish. The last two digits of each stratum number is shown in the figure. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance.

## 6.18 Thorny skate (Raie épineuse) - species code 201 (category LF)

Scientific name: Amblyraja radiata

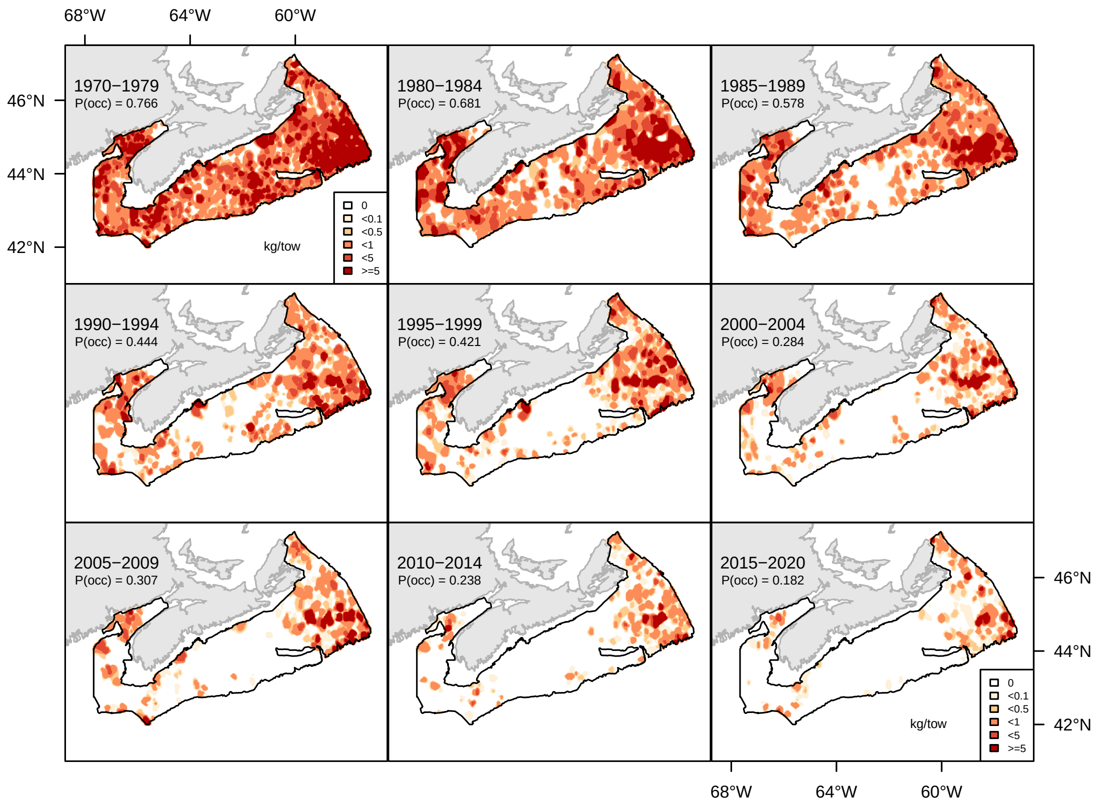



Figure 6.18A. Inverse distance weighted distribution of catch biomass (kg/tow) for Thorny skate. $P(occ)$ is the proportion of tows with catch records for each 5-year period.

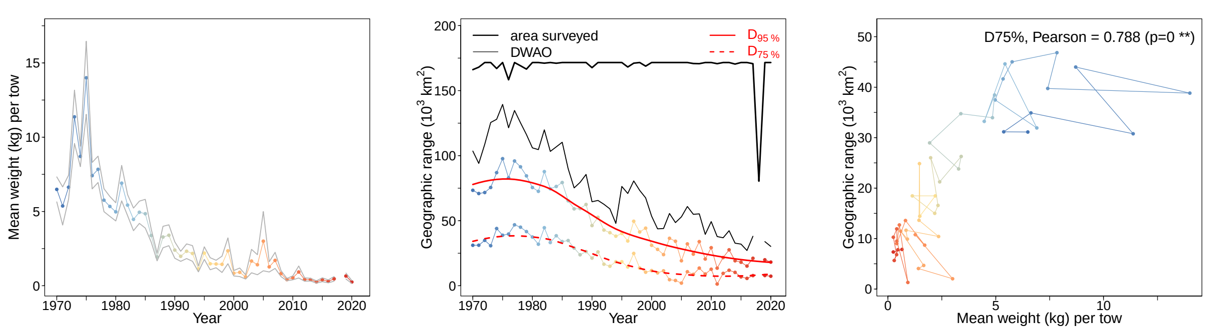



Figure 6.18B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Thorny skate. The predictions from a loess estimator are overlaid on the distribution indices in the middle panel.

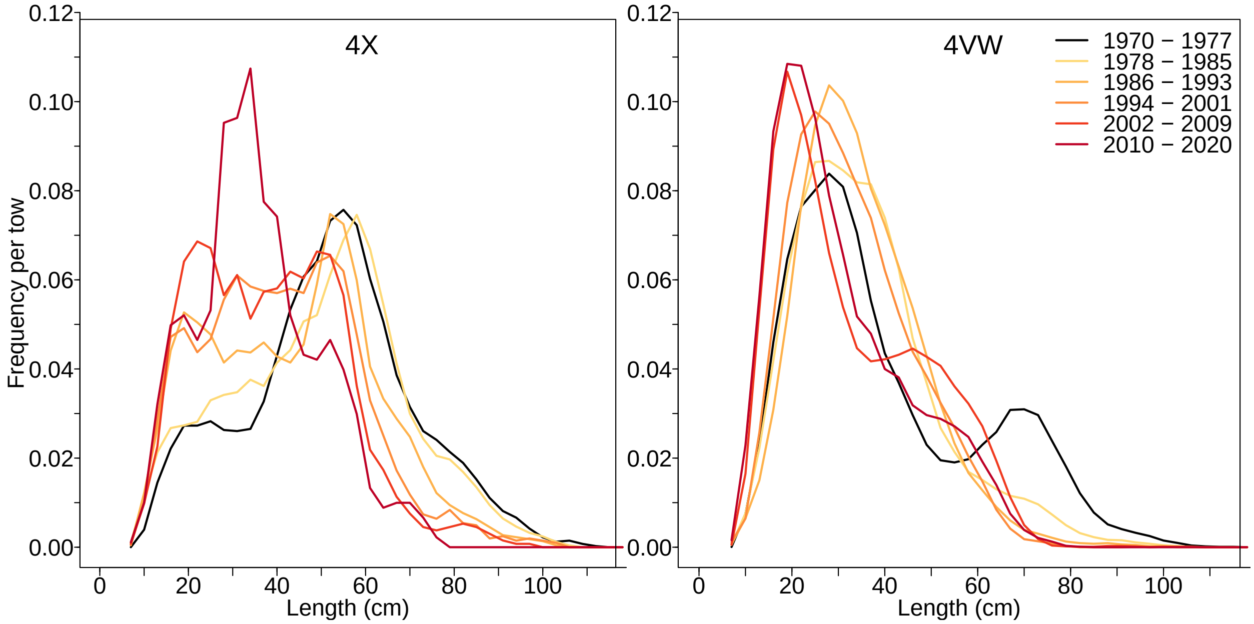



Figure 6.18C. Length frequency distribution in NAFO units 4X and 4VW for Thorny skate.

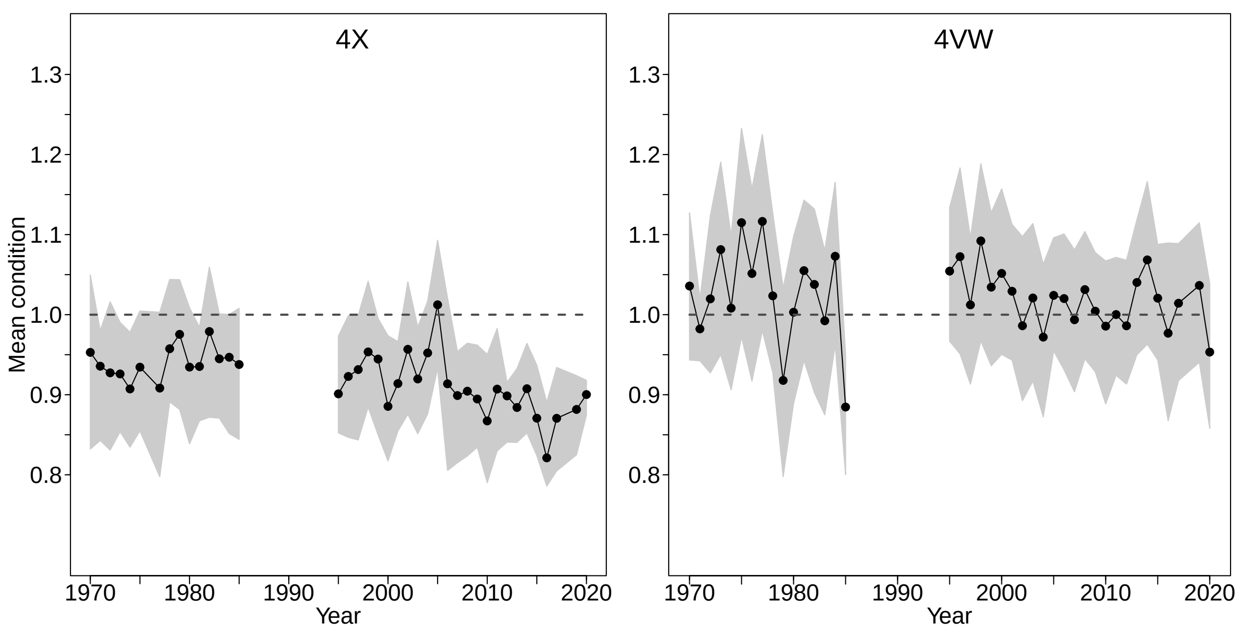
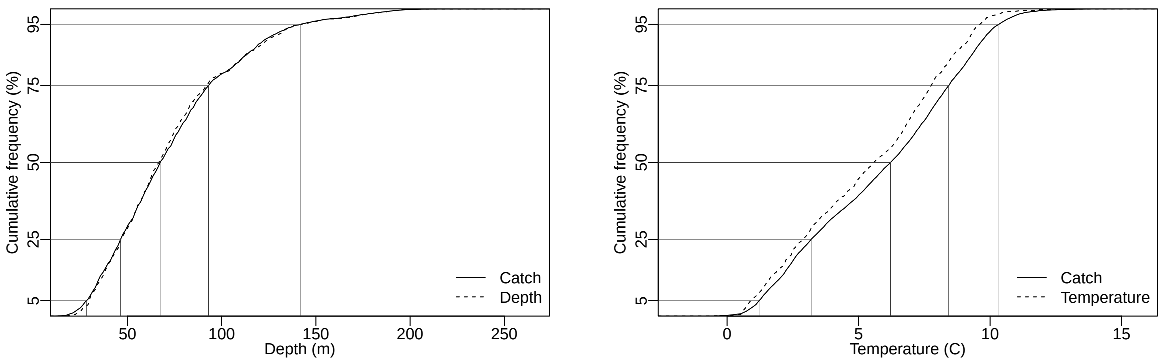
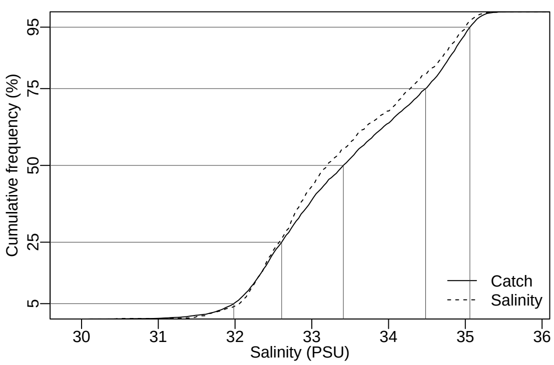



Figure 6.18D. Average fish condition in NAFO units 4X and 4VW for Thorny skate.




| Frequency | Depth | Temperature | Salinity |
|---|---|---|---|
| 0.05 | 29 | 0.8 | 32.04 |
| 0.25 | 46 | 2.8 | 32.57 |
| 0.50 | 66 | 5.5 | 33.19 |
| 0.75 | 92 | 7.7 | 34.27 |
| 0.95 | 142 | 9.6 | 34.99 |

Figure 6.18E. Catch distribution by depth, temperature and salinity of Thorny skate.

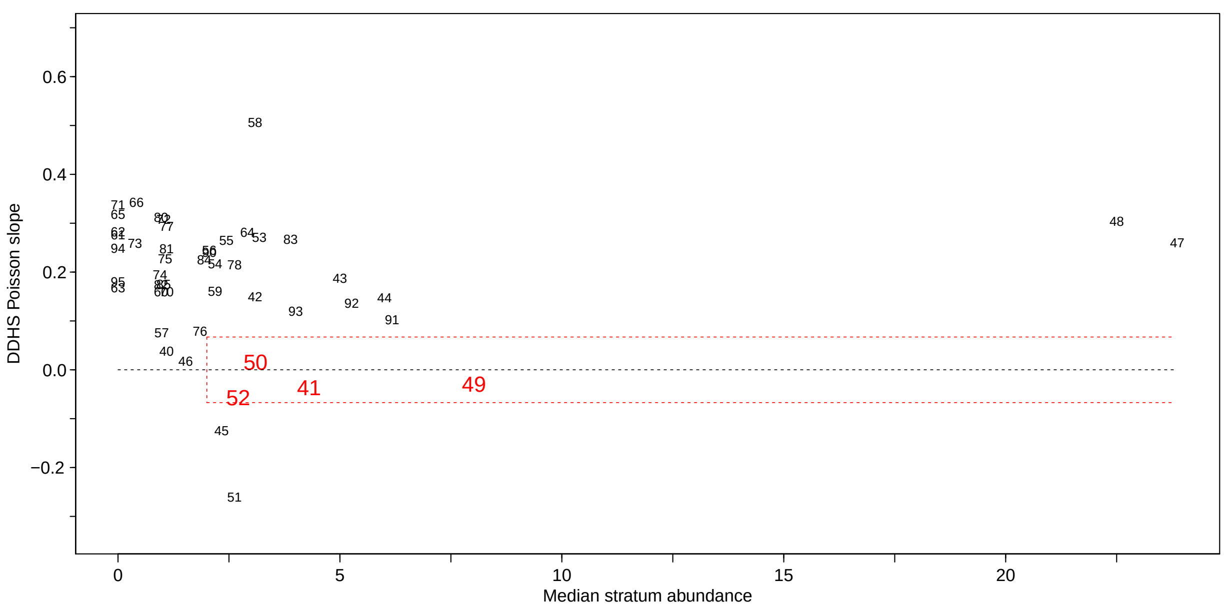



Figure 6.18F. DDHS slopes versus median stratum abundance for Thorny skate. The last two digits of each stratum number is shown in the figure. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance.

### 6.19 Smooth skate (Raie lisse) - species code 202 (category LF)

Scientific name: Malacoraja senta

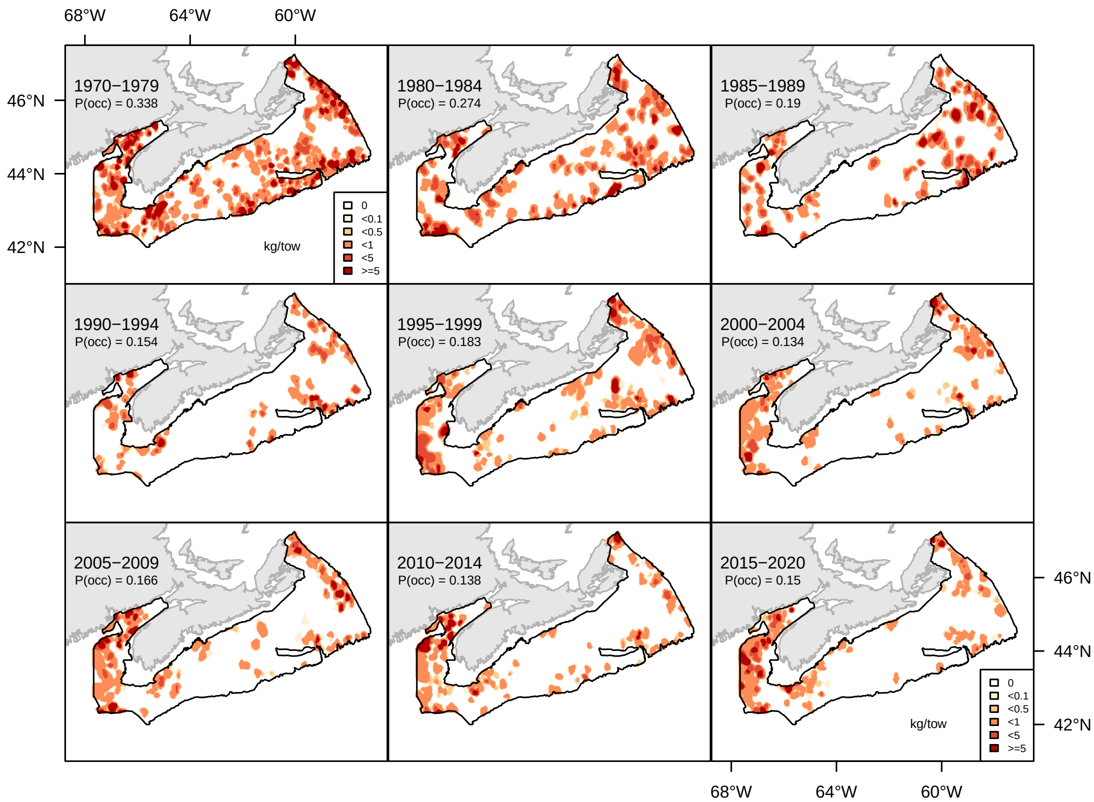



Figure 6.19A. Inverse distance weighted distribution of catch biomass (kg/tow) for Smooth skate. $P(occ)$ is the proportion of tows with catch records for each 5-year period.

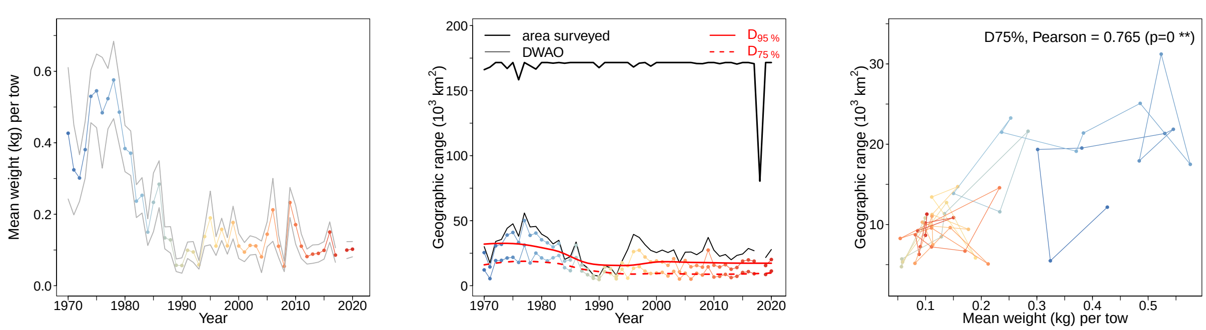



Figure 6.19B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Smooth skate. The predictions from a loess estimator are overlaid on the distribution indices in the middle panel.

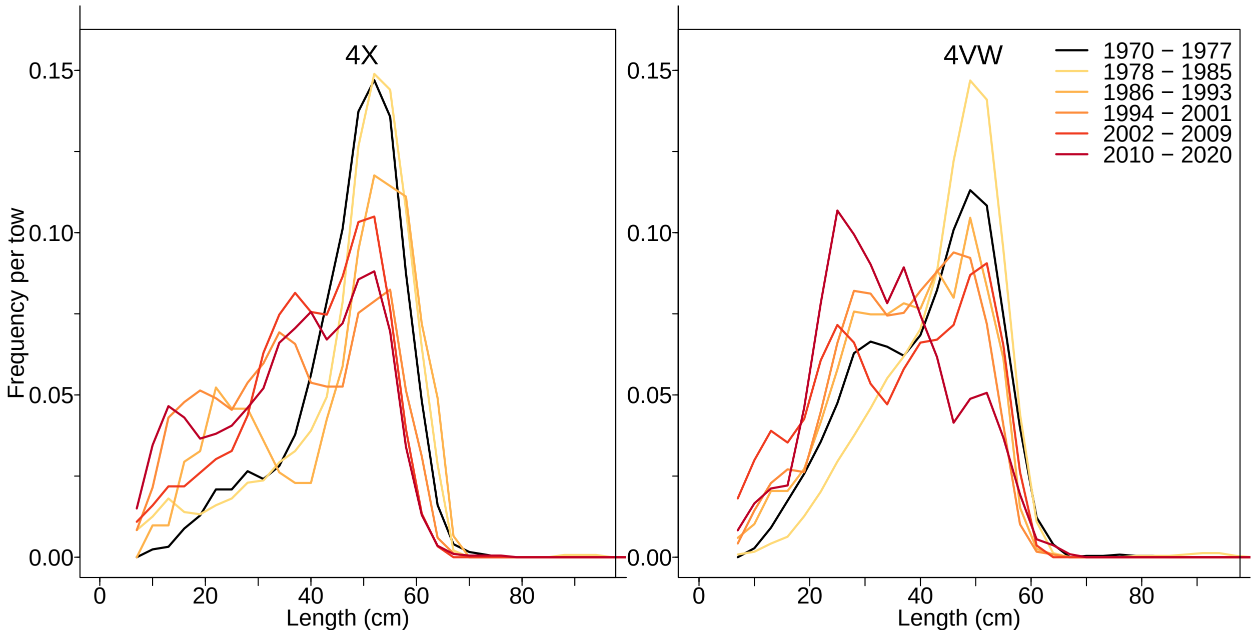



Figure 6.19C. Length frequency distribution in NAFO units 4X and 4VW for Smooth skate.

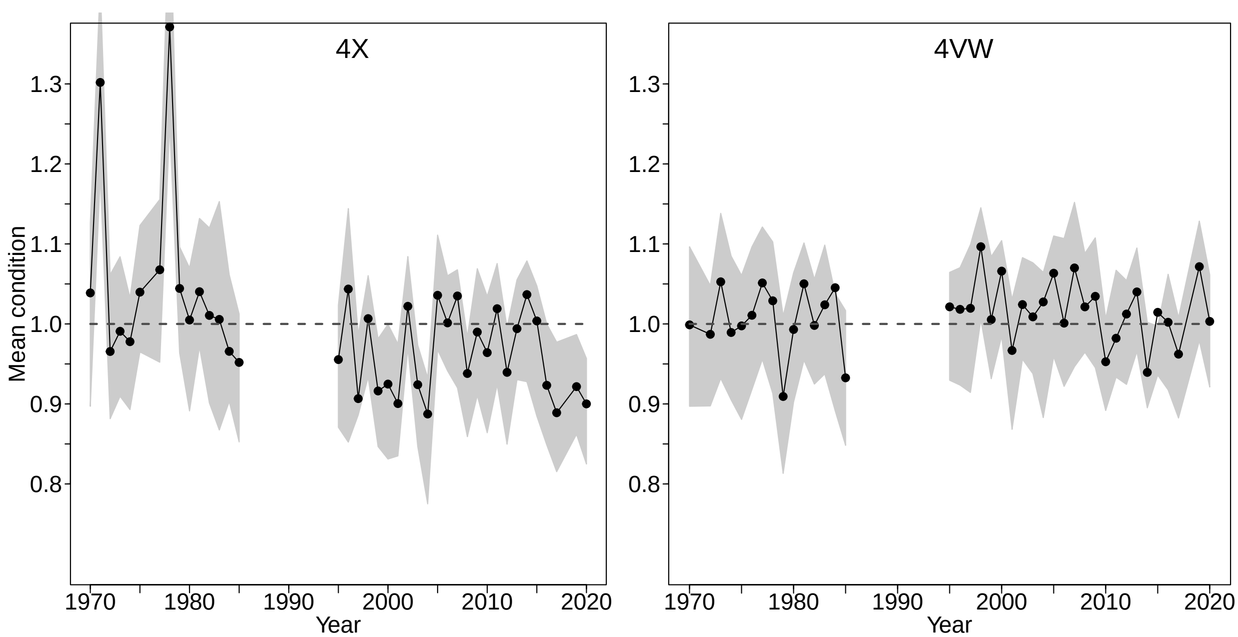
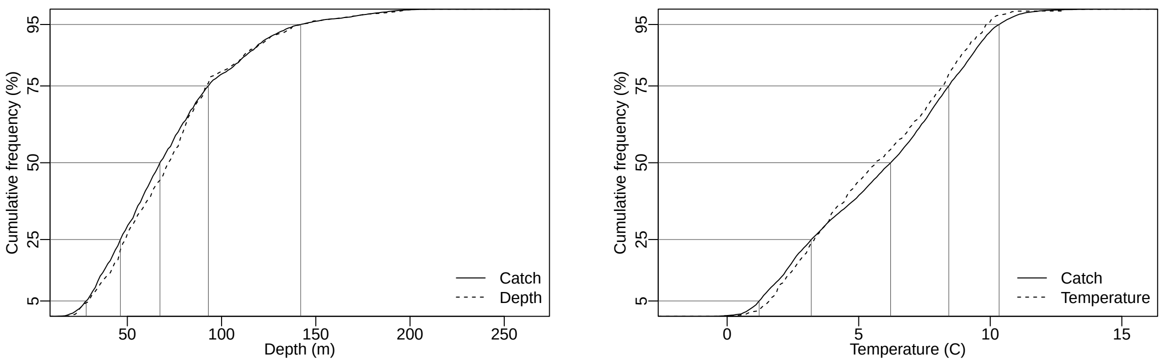
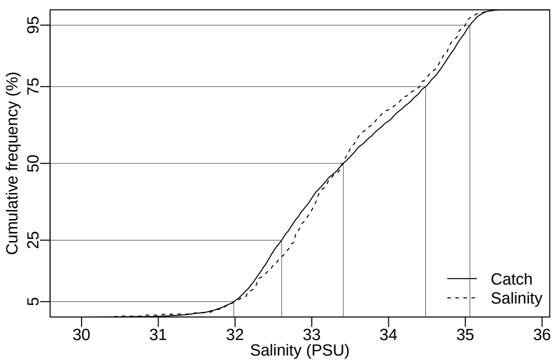



Figure 6.19D. Average fish condition in NAFO units 4X and 4VW for Smooth skate.




| Frequency | Depth | Temperature | Salinity |
|---|---|---|---|
| 0.05 | 29 | 1.6 | 31.98 |
| 0.25 | 49 | 3.3 | 32.76 |
| 0.50 | 72 | 5.6 | 33.38 |
| 0.75 | 90 | 8.2 | 34.40 |
| 0.95 | 142 | 9.8 | 34.99 |

Figure 6.19E. Catch distribution by depth, temperature and salinity of Smooth skate.

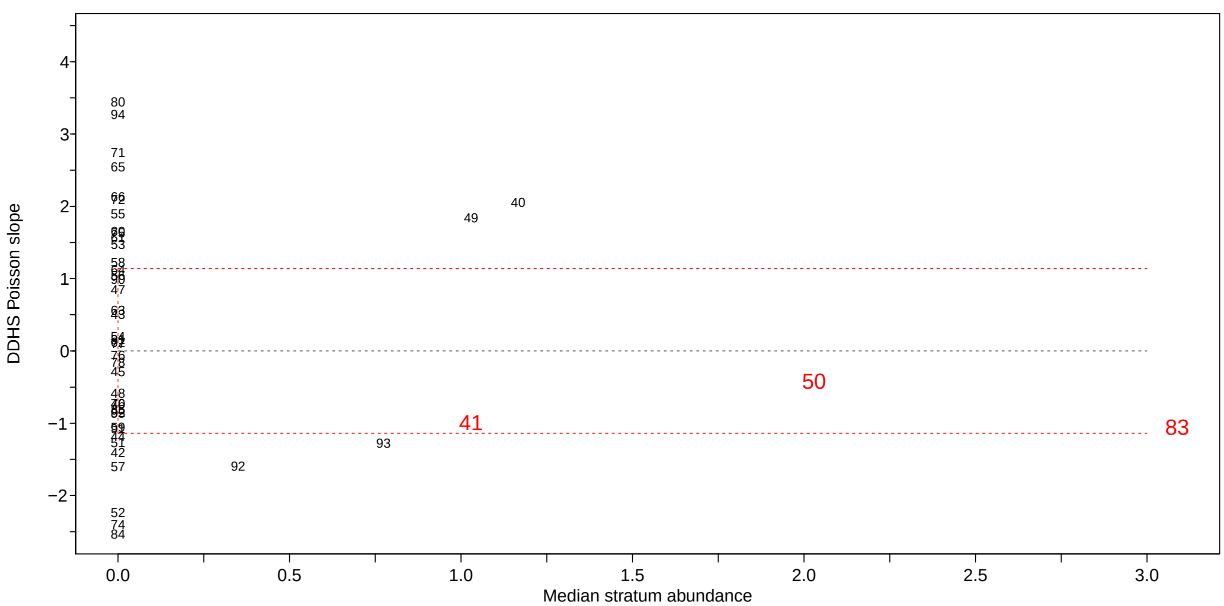



Figure 6.19F. DDHS slopes versus median stratum abundance for Smooth skate. The last two digits of each stratum number is shown in the figure. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance.

## 6.20 Piked dogfish (Aiguillat commun) - species code 220 (category LF)

Scientific name: Squalus acanthias

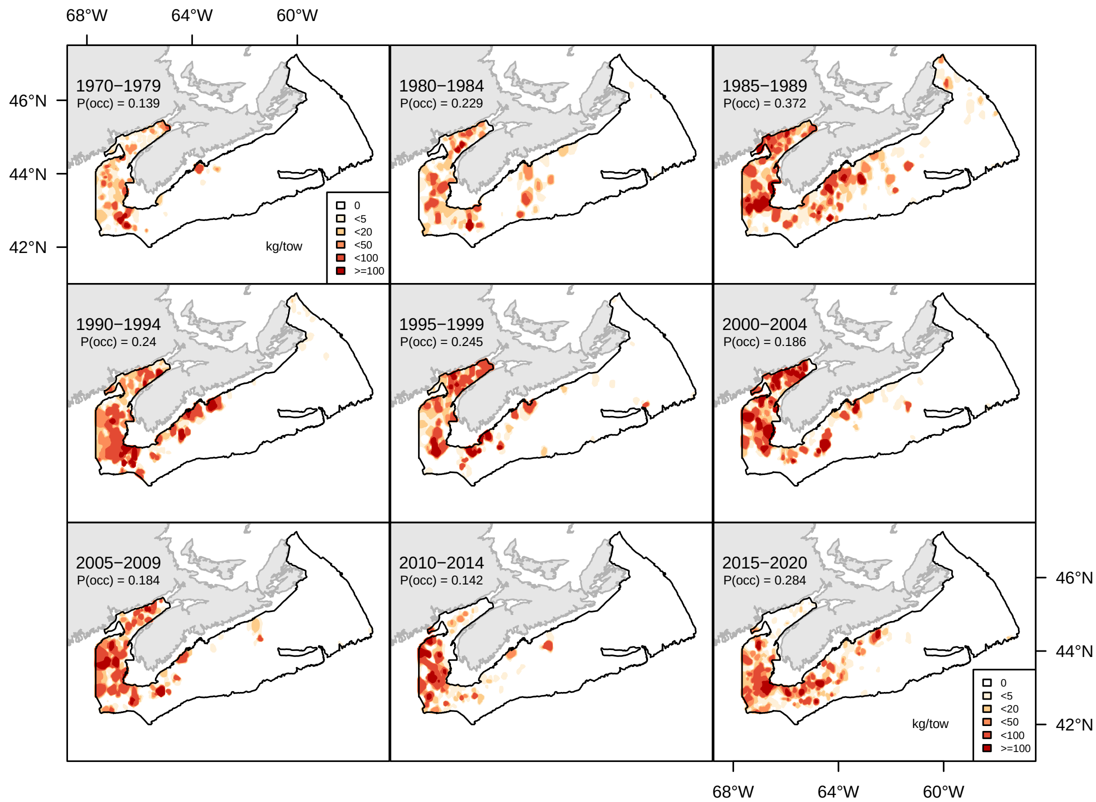



Figure 6.20A. Inverse distance weighted distribution of catch biomass (kg/tow) for Piked dogfish. $P(occ)$ is the proportion of tows with catch records for each 5-year period.

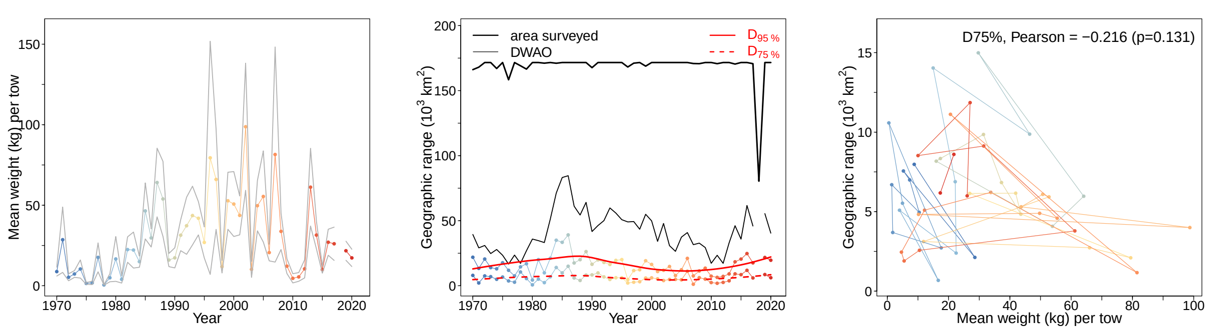



Figure 6.20B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Piked dogfish. The predictions from a loess estimator are overlaid on the distribution indices in the middle panel.

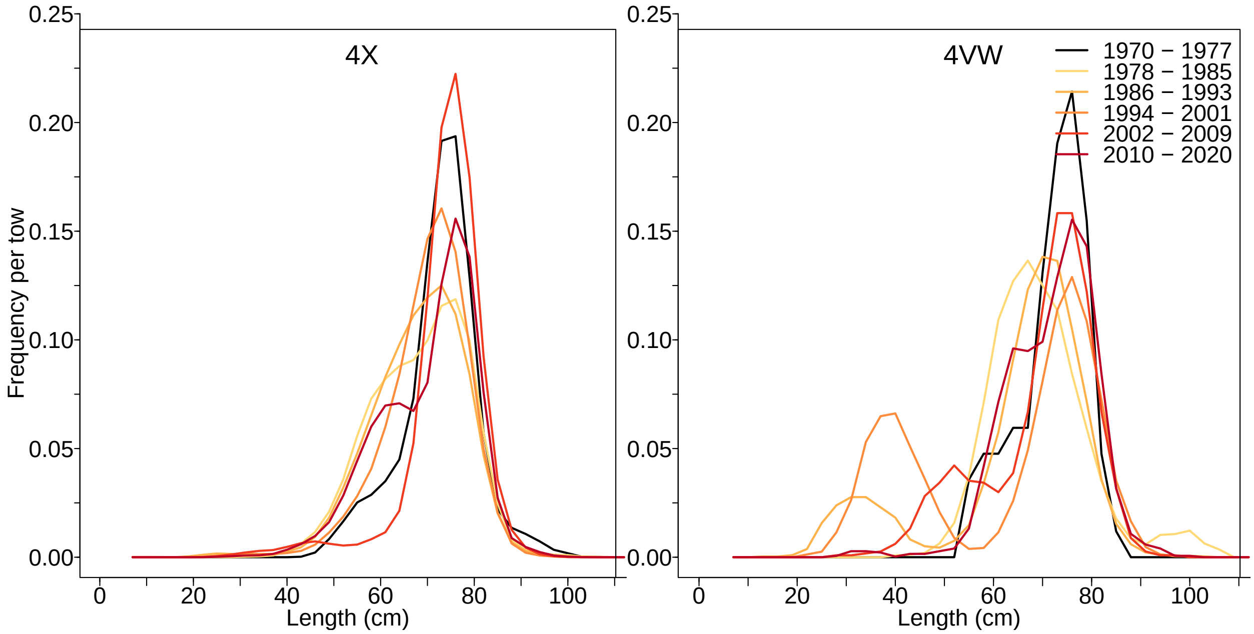



Figure 6.20C. Length frequency distribution in NAFO units 4X and 4VW for Piked dogfish.

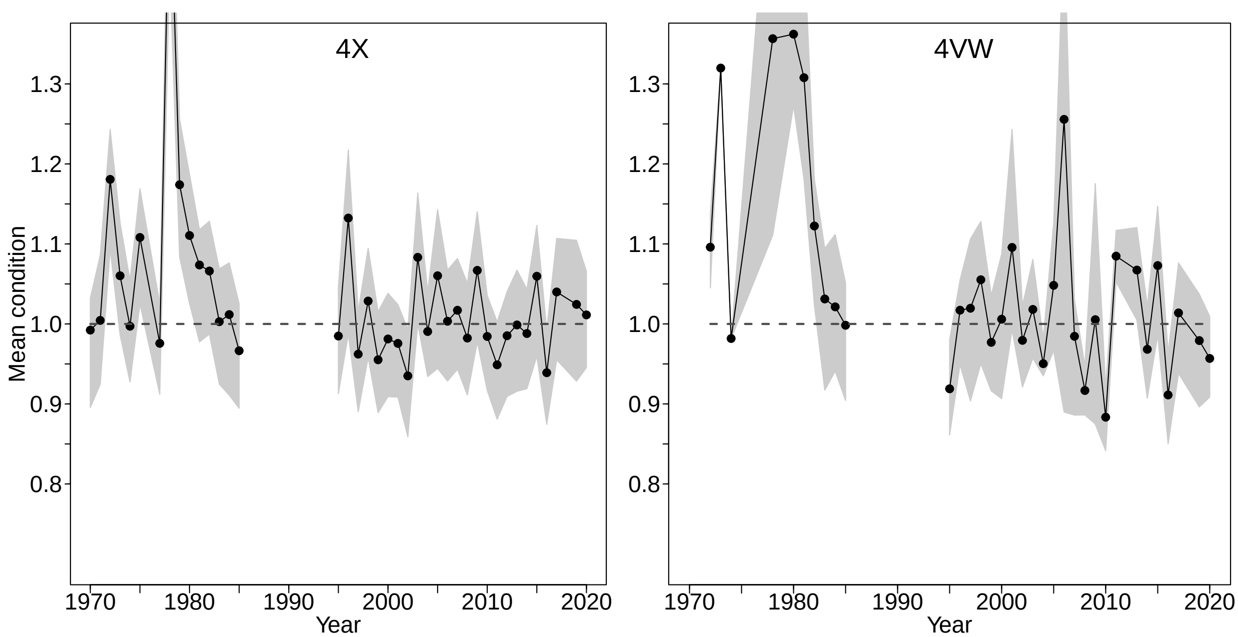
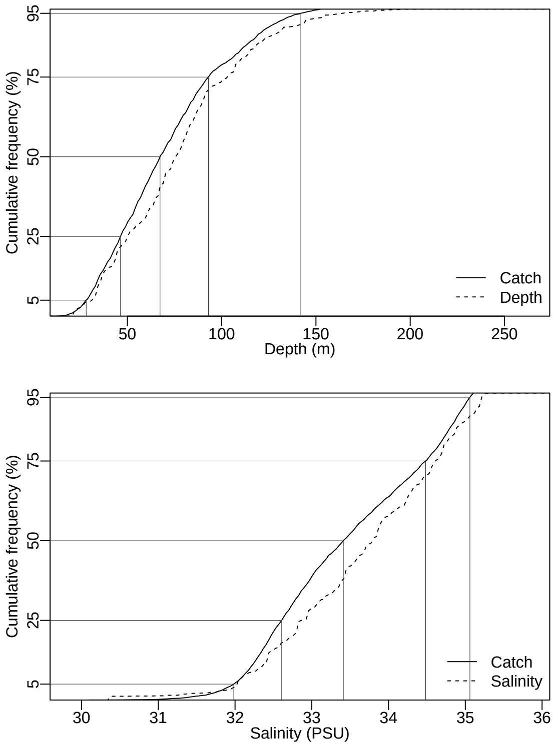



Figure 6.20D. Average fish condition in NAFO units 4X and 4VW for Piked dogfish.




| Frequency | Depth | Temperature | Salinity |
|---|---|---|---|
| 0.05 | 30 | 1.6 | 32.01 |
| 0.25 | 49 | 3.9 | 32.86 |
| 0.50 | 74 | 6.9 | 33.78 |
| 0.75 | 102 | 8.7 | 34.60 |
| 0.95 | 163 | 11.4 | 35.18 |

Figure 6.20E. Catch distribution by depth, temperature and salinity of Piked dogfish.

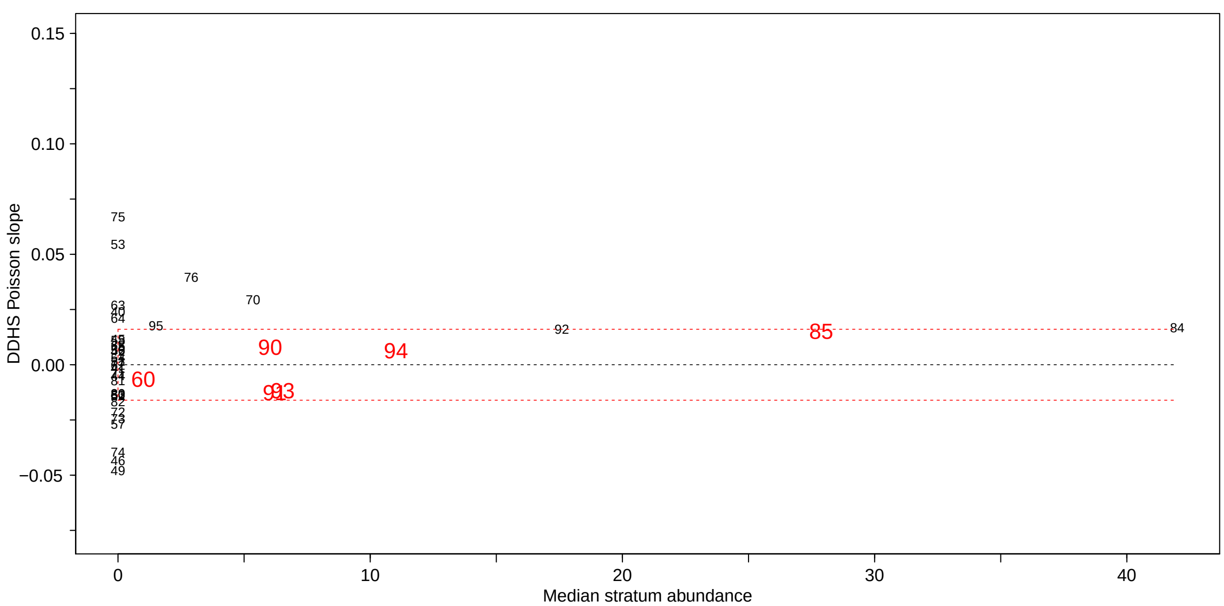



Figure 6.20F. DDHS slopes versus median stratum abundance for Piked dogfish. The last two digits of each stratum number is shown in the figure. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance.

### 6.21 North. shortfin squid (Encornet rouge nord.) - species code 4511 (category LF)

Scientific name: Illex illecebrosus

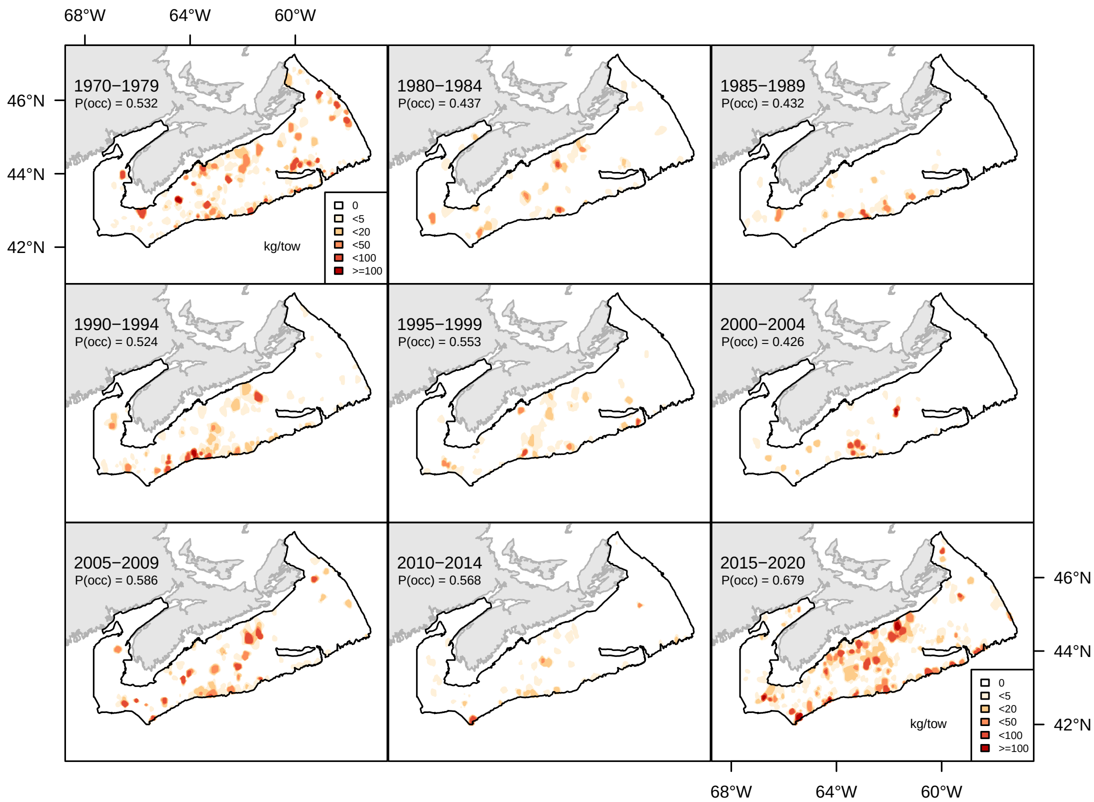



Figure 6.21A. Inverse distance weighted distribution of catch biomass (kg/tow) for North. shortfin squid. $P(occ)$ is the proportion of tows with catch records for each 5-year period.

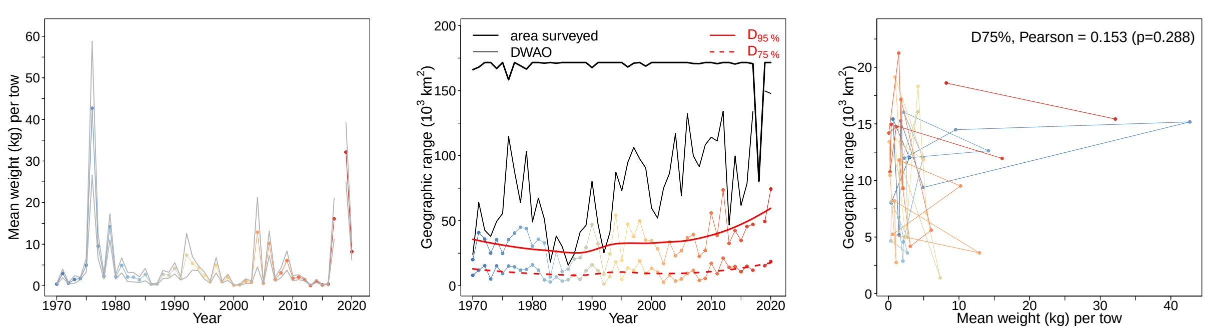



Figure 6.21B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of North. shortfin squid. The predictions from a loess estimator are overlaid on the distribution indices in the middle panel.

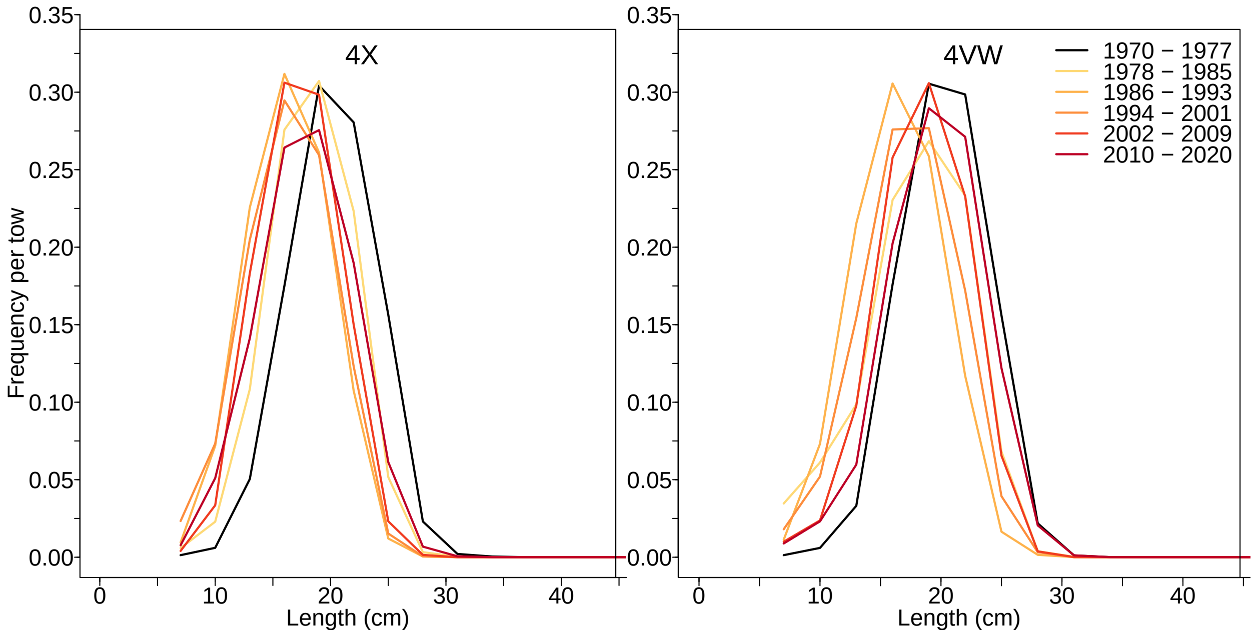



Figure 6.21C. Length frequency distribution in NAFO units 4X and 4VW for North. shortfin squid.

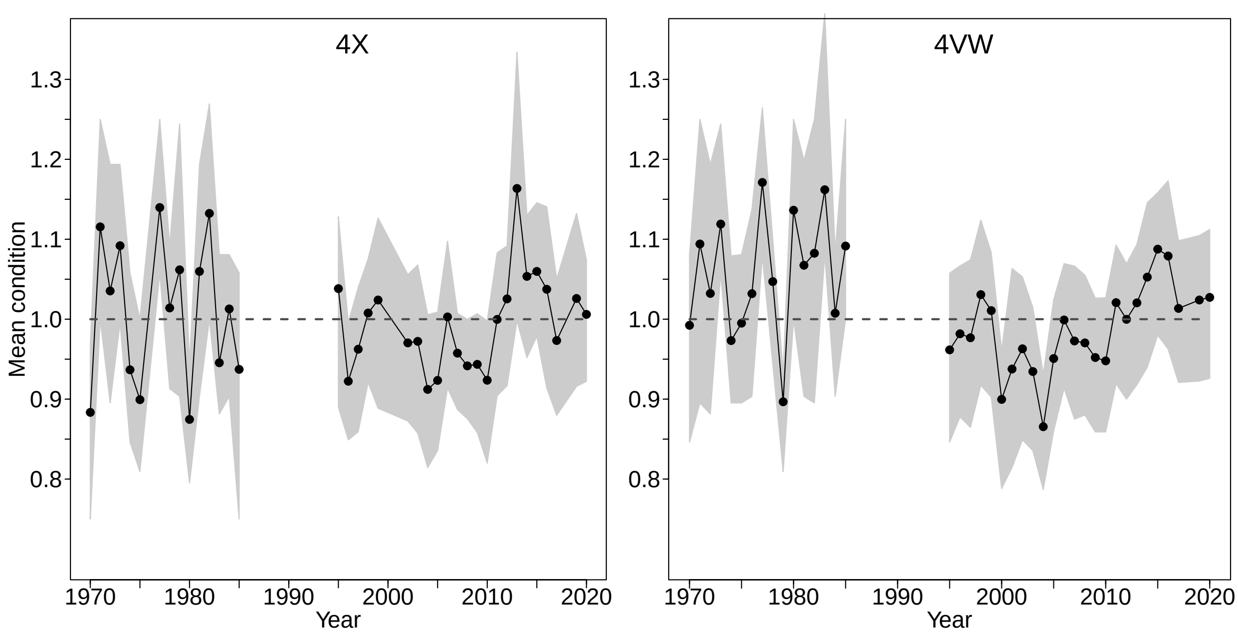
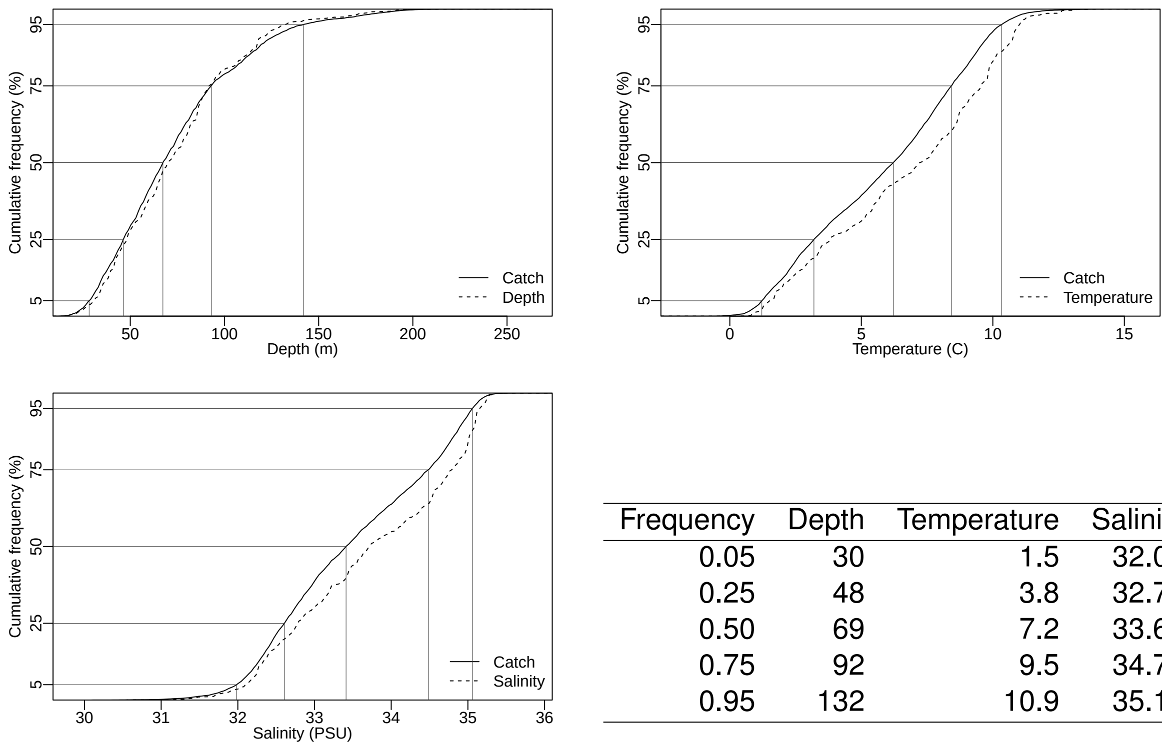



Figure 6.21D. Average fish condition in NAFO units 4X and 4VW for North. shortfin squid.



| Frequency | Depth | Temperature | Salinity |
|---|---|---|---|
| 0.05 | 30 | 1.5 | 32.08 |
| 0.25 | 48 | 3.8 | 32.76 |
| 0.50 | 69 | 7.2 | 33.68 |
| 0.75 | 92 | 9.5 | 34.76 |
| 0.95 | 132 | 10.9 | 35.15 |

Figure 6.21E. Catch distribution by depth, temperature and salinity of North. shortfin squid.

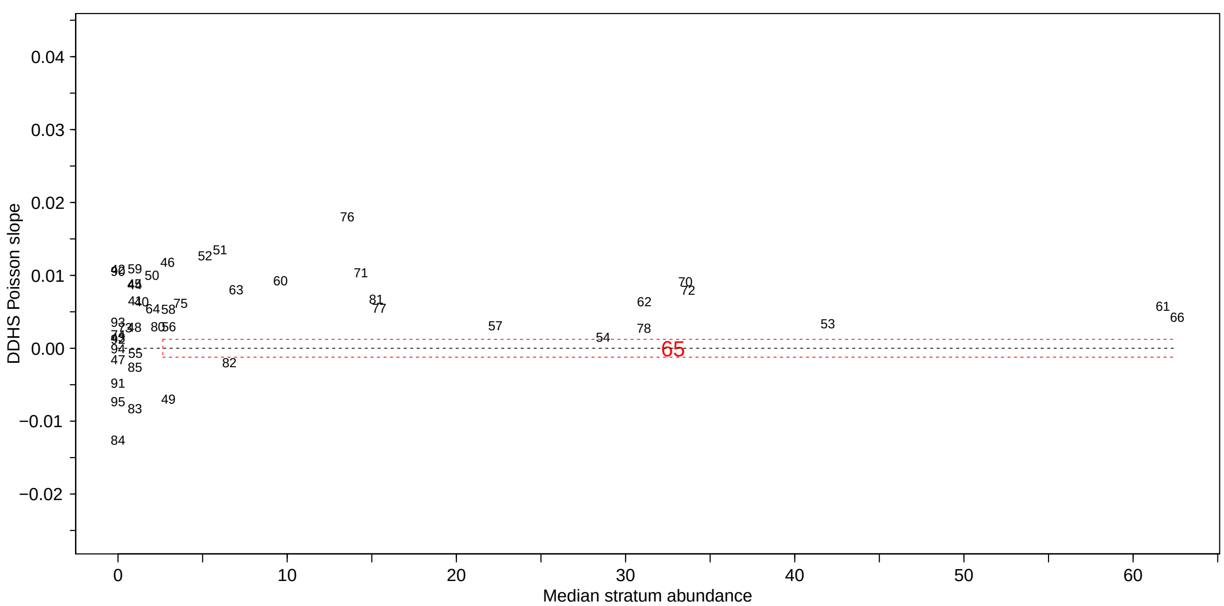


Figure 6.21F. DDHS slopes versus median stratum abundance for North. shortfin squid. The last two digits of each stratum number is shown in the figure. The red box indicates strata of particular importance for a species by identifying slopes that are within a standard error from zero and that are within the top 25% of median abundance.

## 6.22 Atlantic hagfish (Myxine du nord) - species code 241 (category LI)

Scientific name: Myxine glutinosa

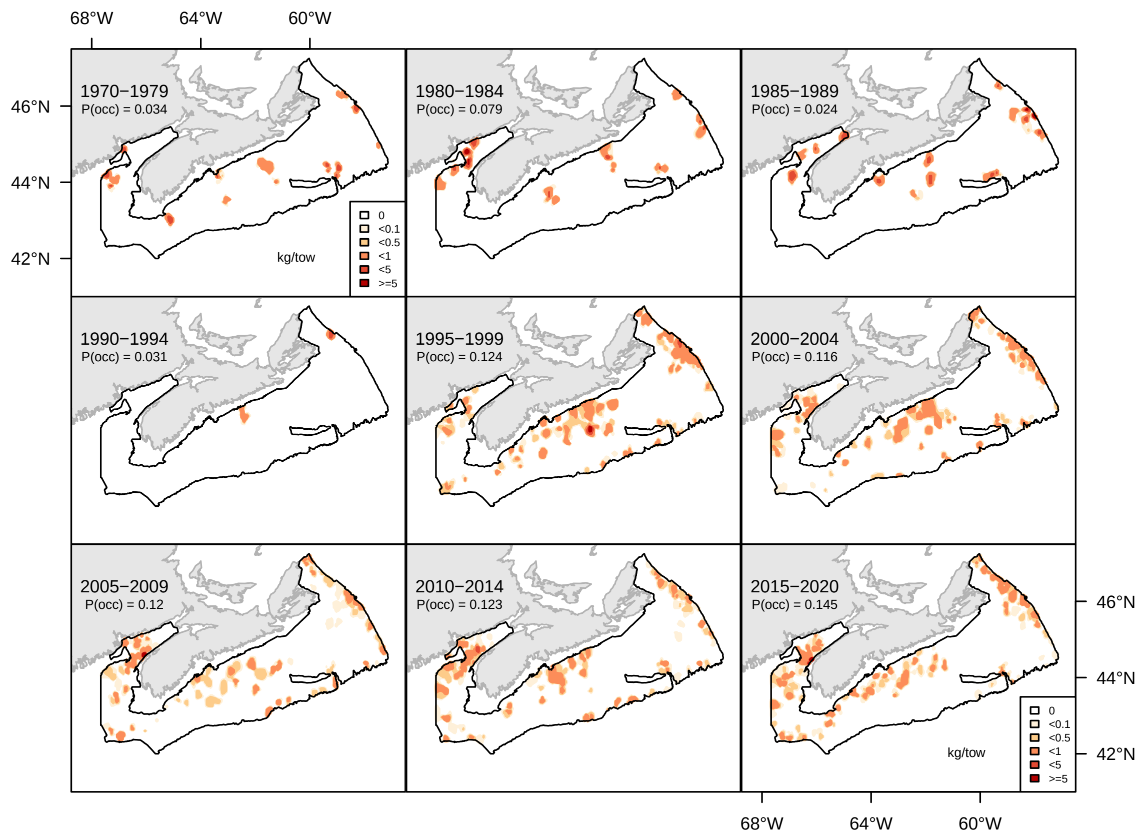



Figure 6.22A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic hagfish.

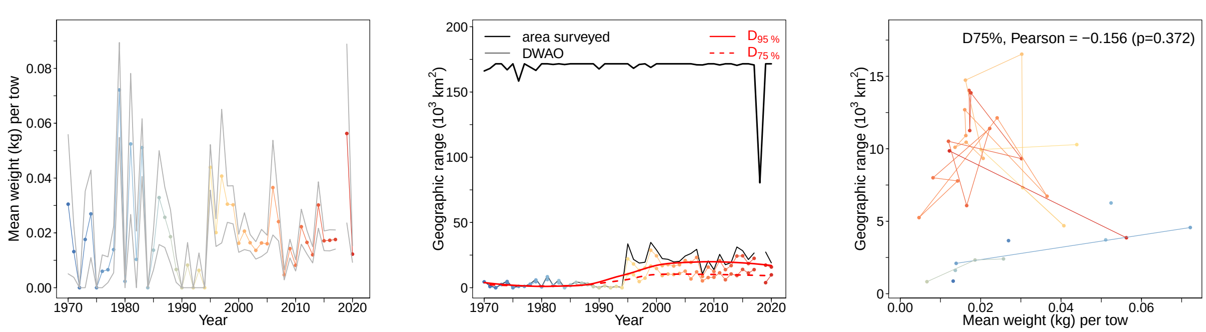



Figure 6.22B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic hagfish.

## 6.23 Cusk (Brosme) - species code 15 (category LI)

Scientific name: Brosme brosme

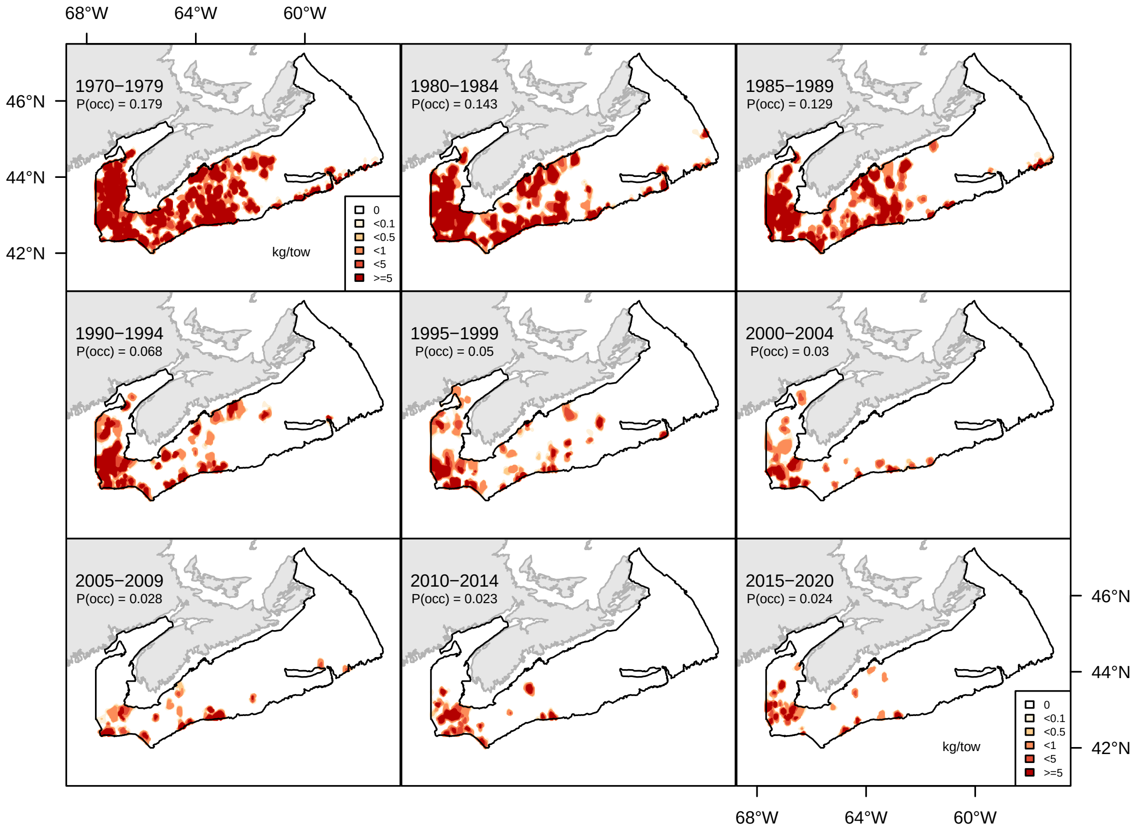



Figure 6.23A. Inverse distance weighted distribution of catch biomass (kg/tow) for Cusk.

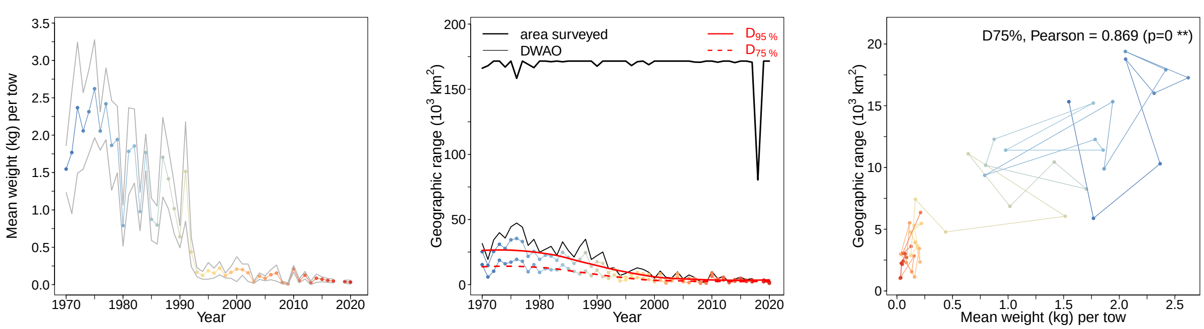



Figure 6.23B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Cusk.

## 6.24 Longfin hake (Merluche à longues nageoires) - species code 112 (category LI)

Scientific name: Phycis chesteri

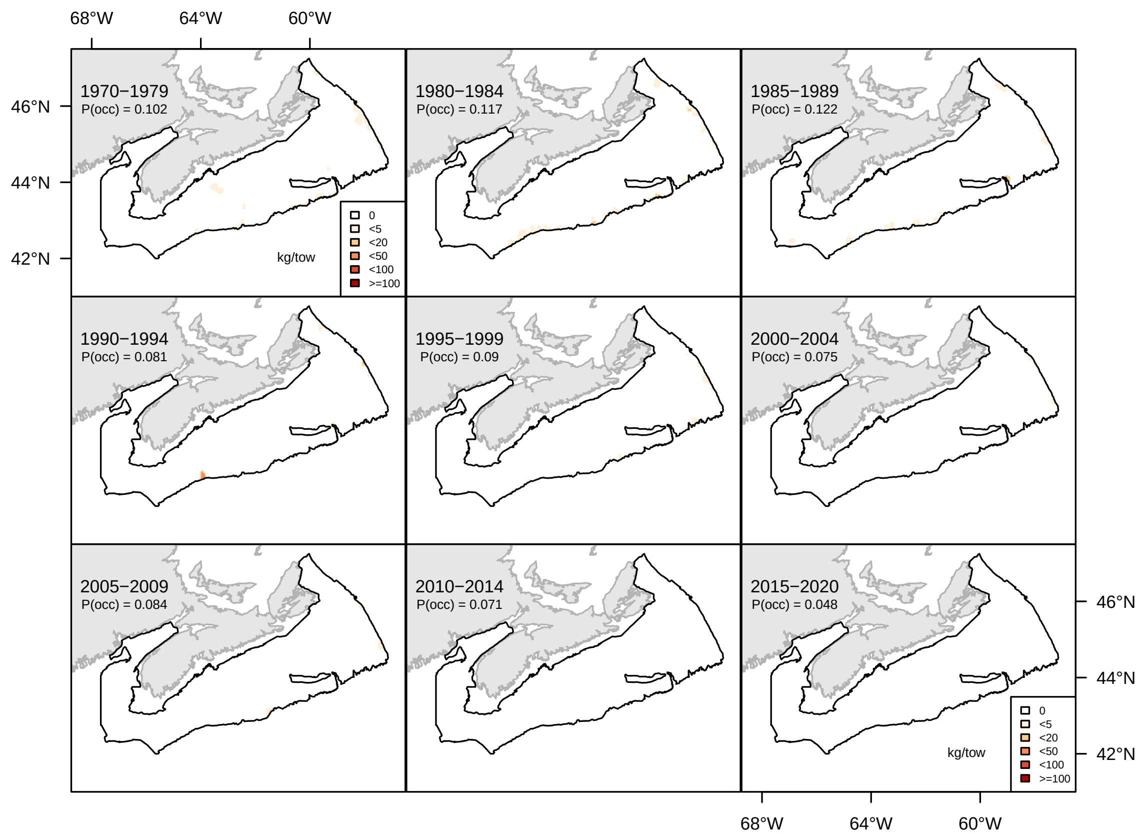



Figure 6.24A. Inverse distance weighted distribution of catch biomass (kg/tow) for Longfin hake.

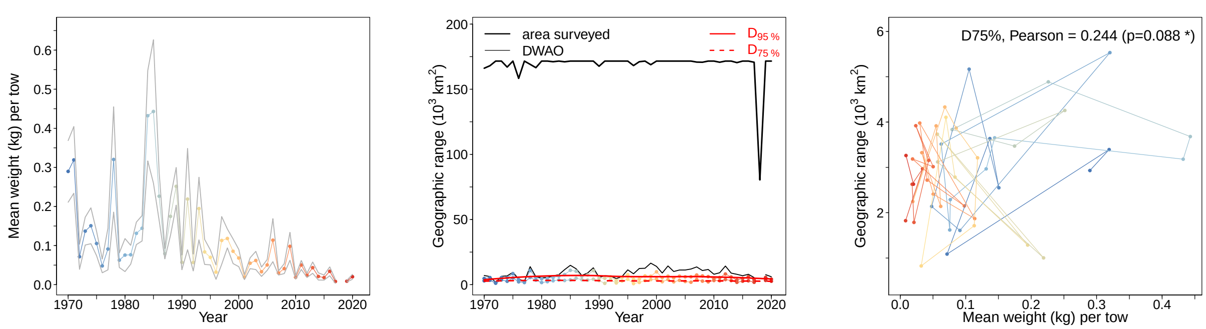



Figure 6.24B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Longfin hake.

### 6.25 Marlin-spike grenadier (Grenadier Grand Banc) - species code 410 (category LI)

Scientific name: [Nezumia bairdii]

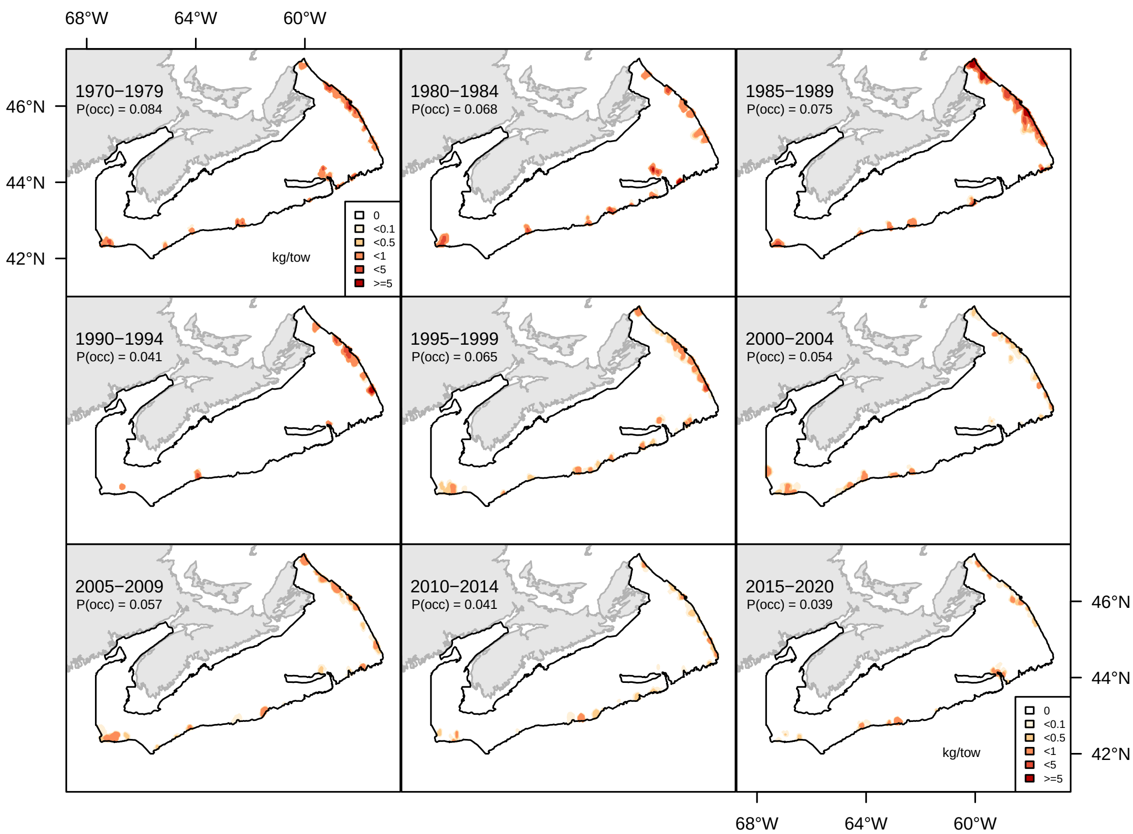



Figure 6.25A. Inverse distance weighted distribution of catch biomass (kg/tow) for Marlin-spike grenadier.

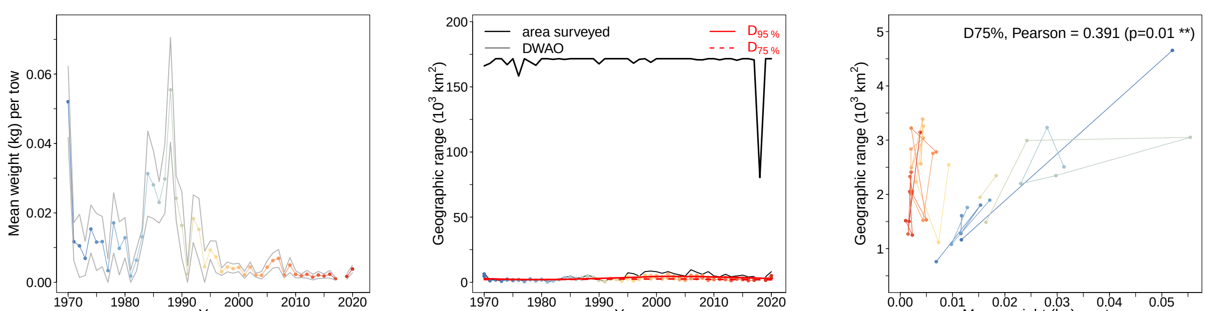



Figure 6.25B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Marlin-spike grenadier.

## 6.26 Moustache sculpin (Faux-trigle armé) - species code 304 (category LI)

Scientific name: Triglops murrayi

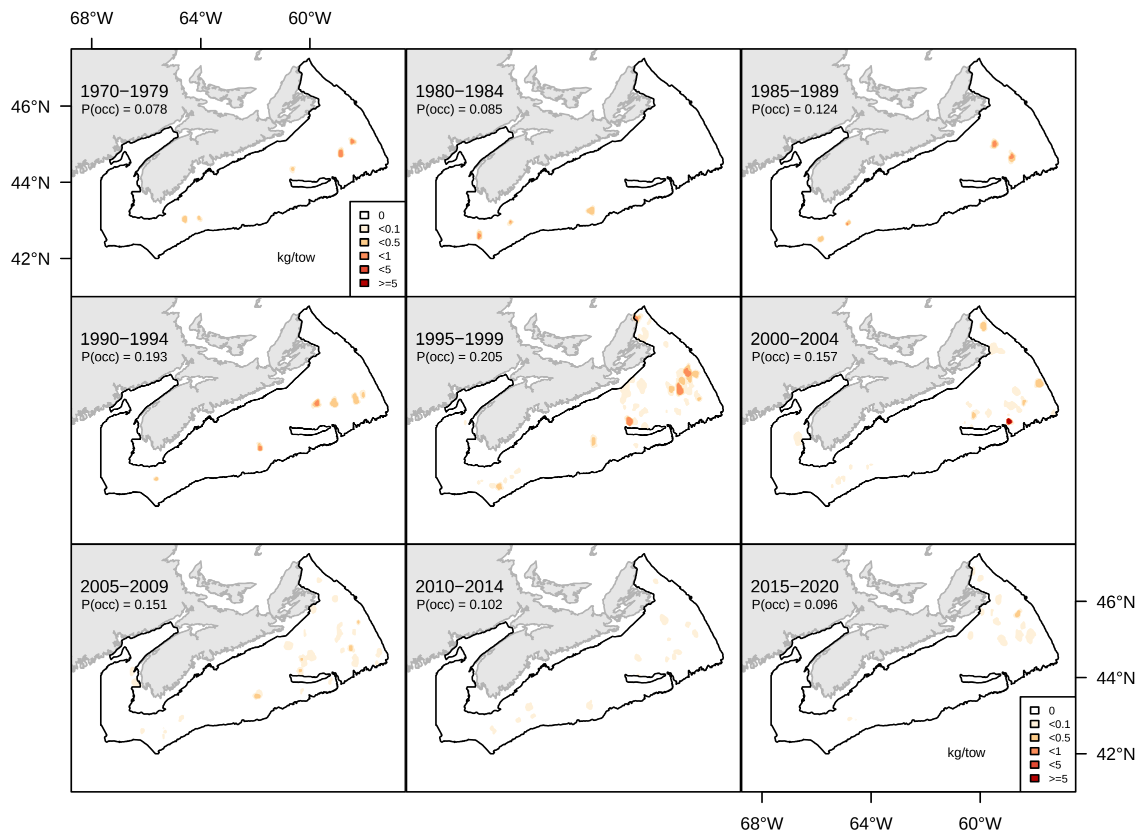



Figure 6.26A. Inverse distance weighted distribution of catch biomass (kg/tow) for Moustache sculpin.

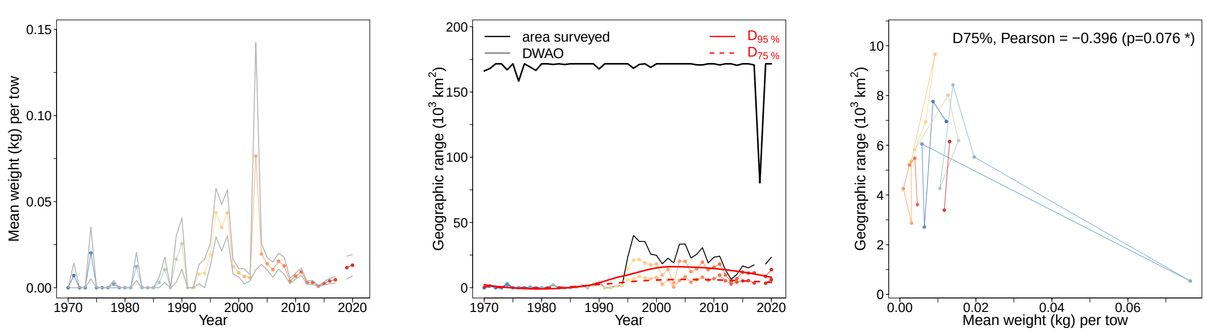



Figure 6.26B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Moustache sculpin.

## 6.27 Lumpfish (Lompe) - species code 501 (category LI)

Scientific name: [Cyclopterus lumpus]

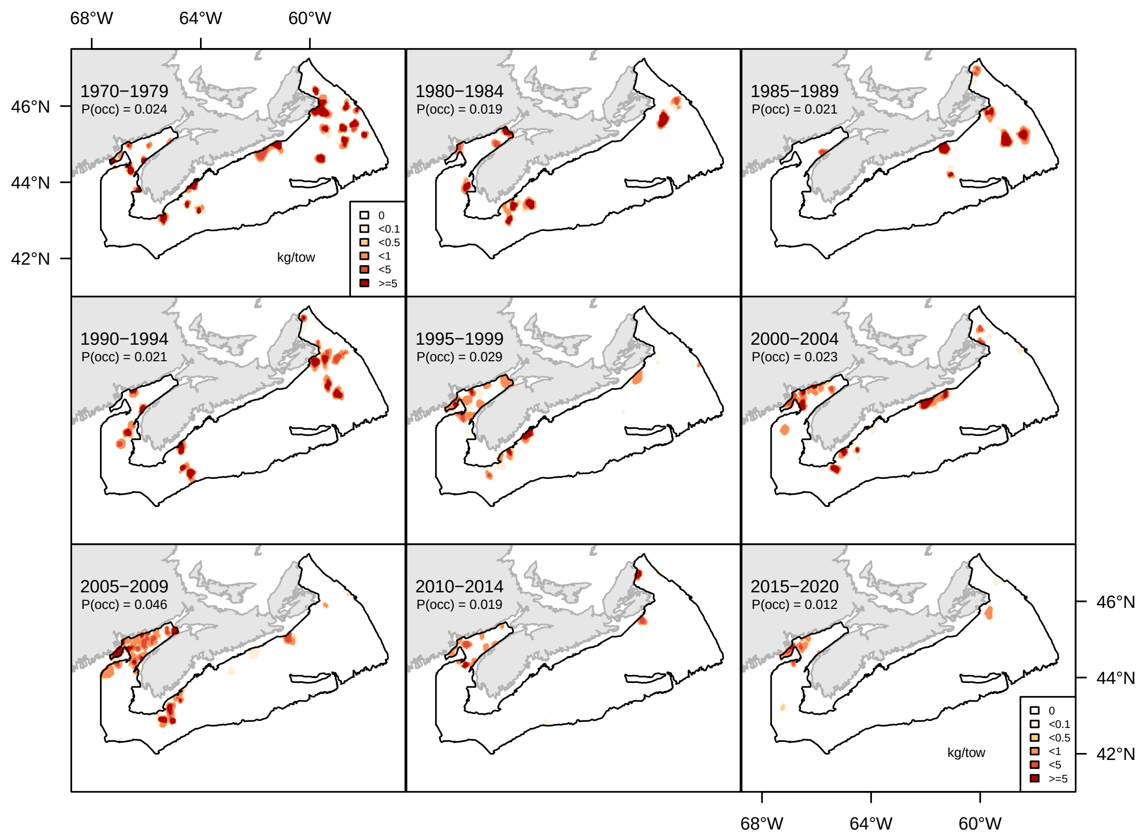



Figure 6.27A. Inverse distance weighted distribution of catch biomass (kg/tow) for Lumpfish.

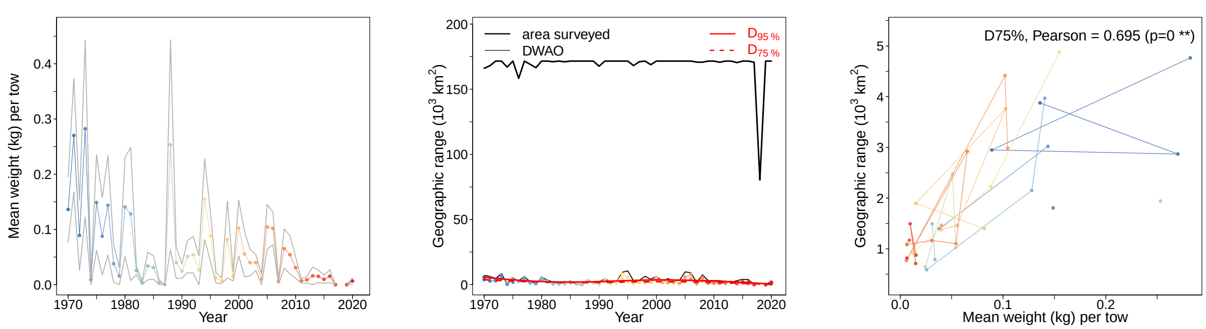



Figure 6.27B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Lumpfish.

### 6.28 Ocean pout (Loquette d'Amérique) - species code 640 (category LI)

Scientific name: [Zoarces americanus]

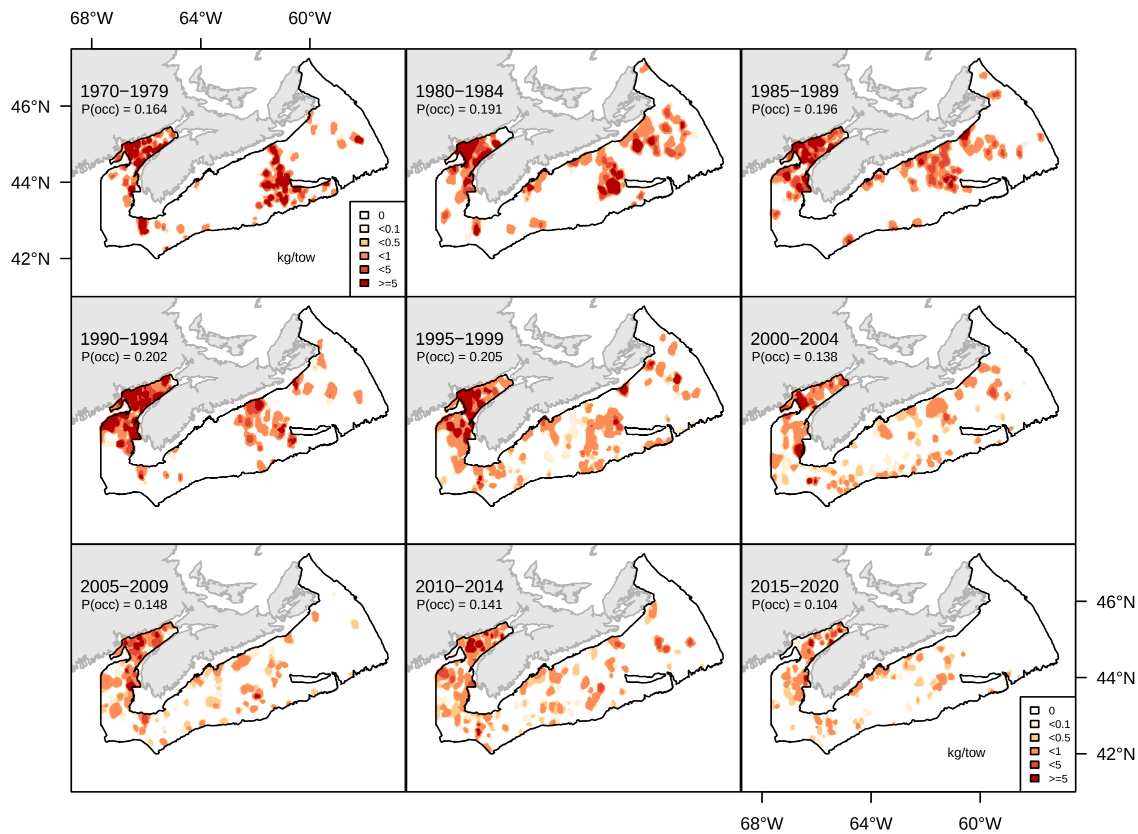



Figure 6.28A. Inverse distance weighted distribution of catch biomass (kg/tow) for Ocean pout.

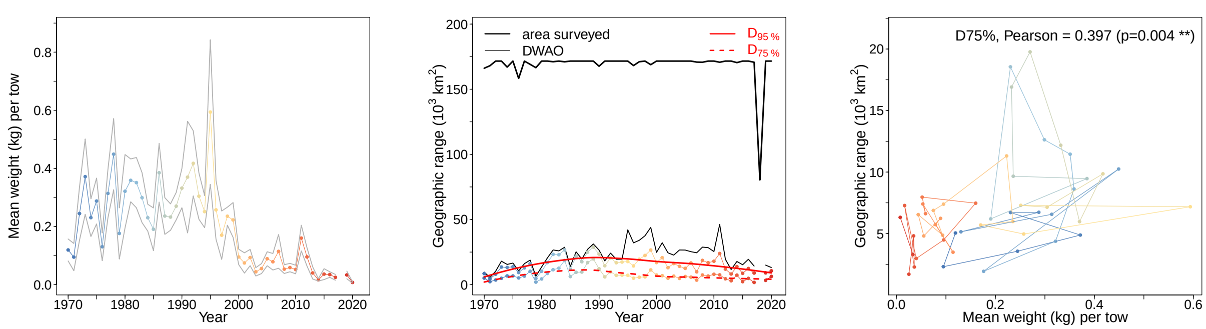



Figure 6.28B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Ocean pout.

### 6.29 Vahl's eelpout (Lycode à carreaux) - species code 647 (category LI)

Scientific name: [Lycodes vahlii]

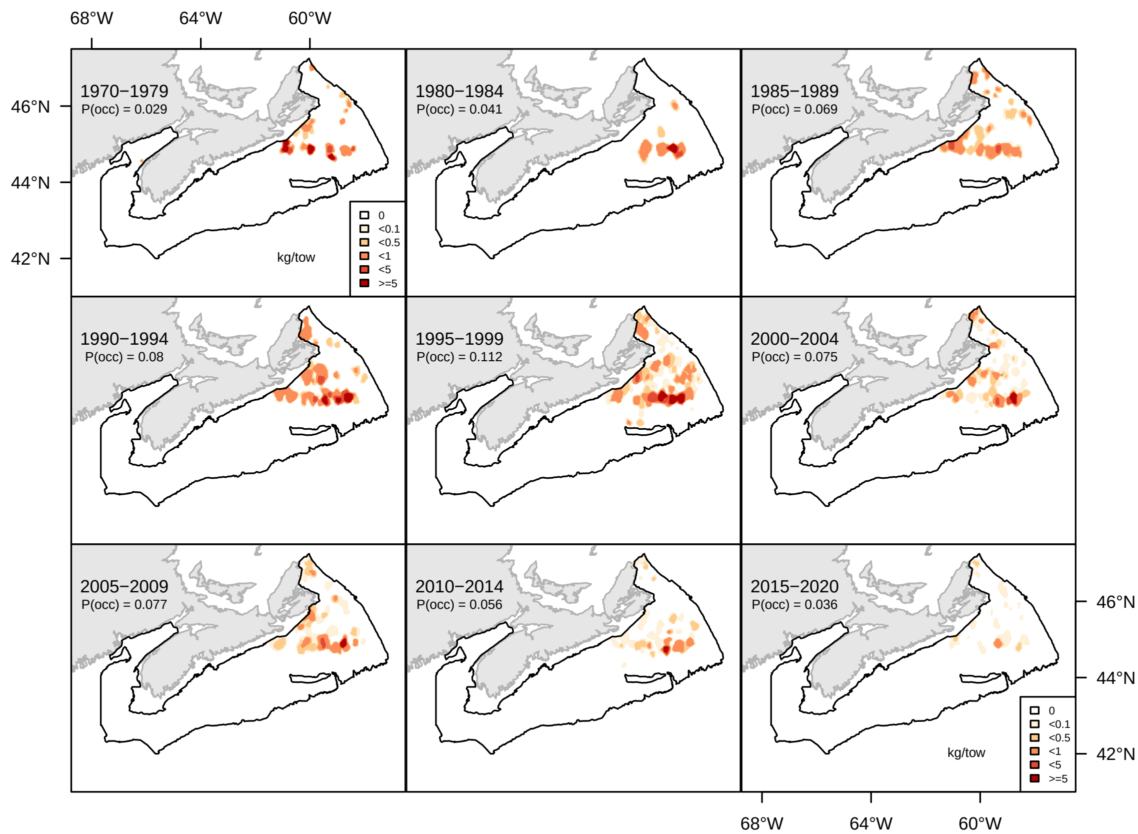



Figure 6.29A. Inverse distance weighted distribution of catch biomass (kg/tow) for Vahl's eelpout.

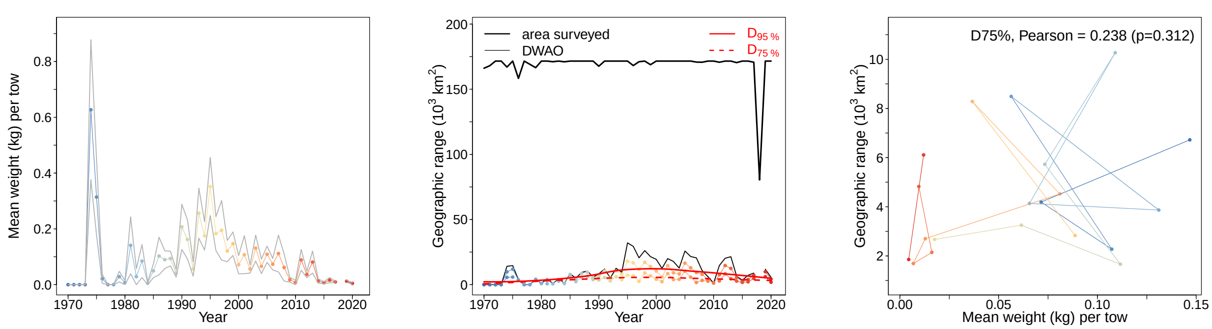



Figure 6.29B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Vahl's eelpout.

### 6.30 American shad (Alose savoureuse) - species code 61 (category LI)

Scientific name: Alosa sapidissima

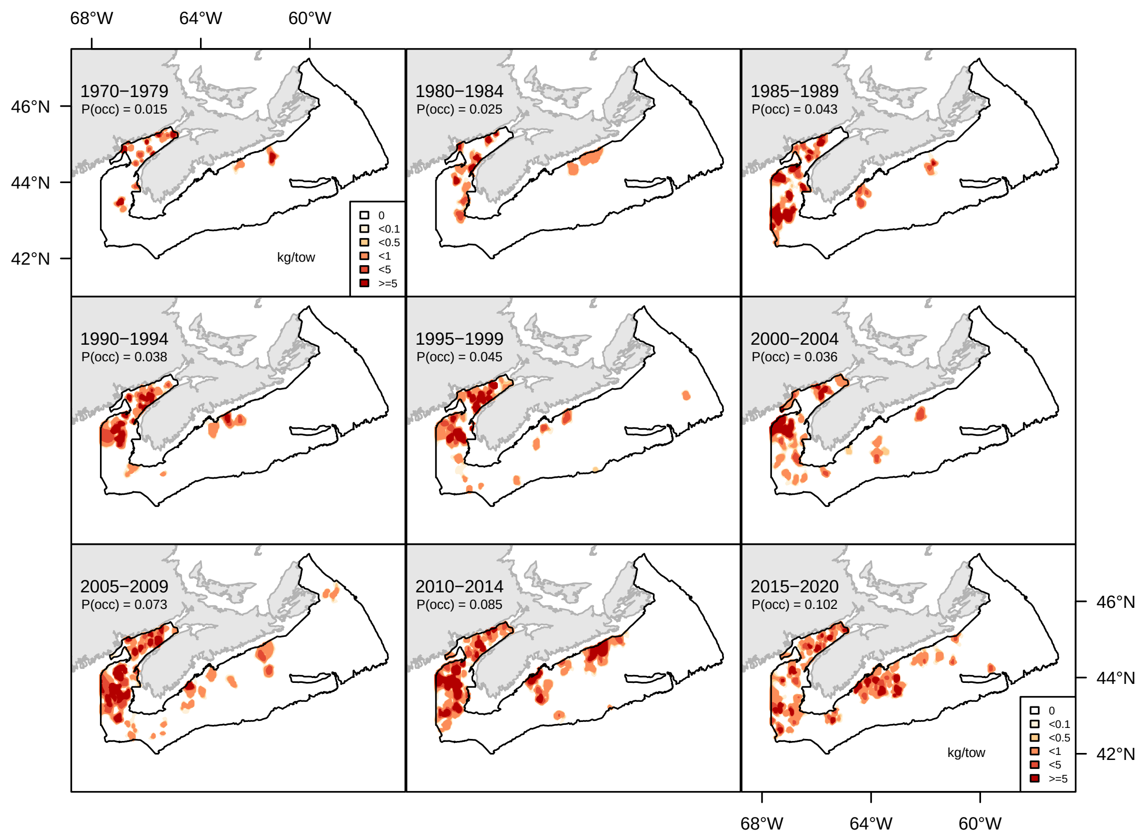



Figure 6.30A. Inverse distance weighted distribution of catch biomass (kg/tow) for American shad.

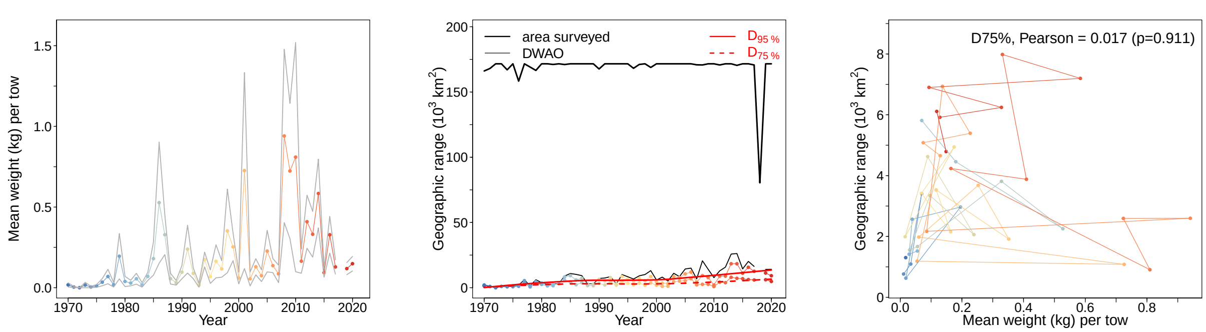



Figure 6.30B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of American shad.

## 6.31 Alewife (Gaspareau) - species code 62 (category LI)

Scientific name: Alosa pseudoharengus

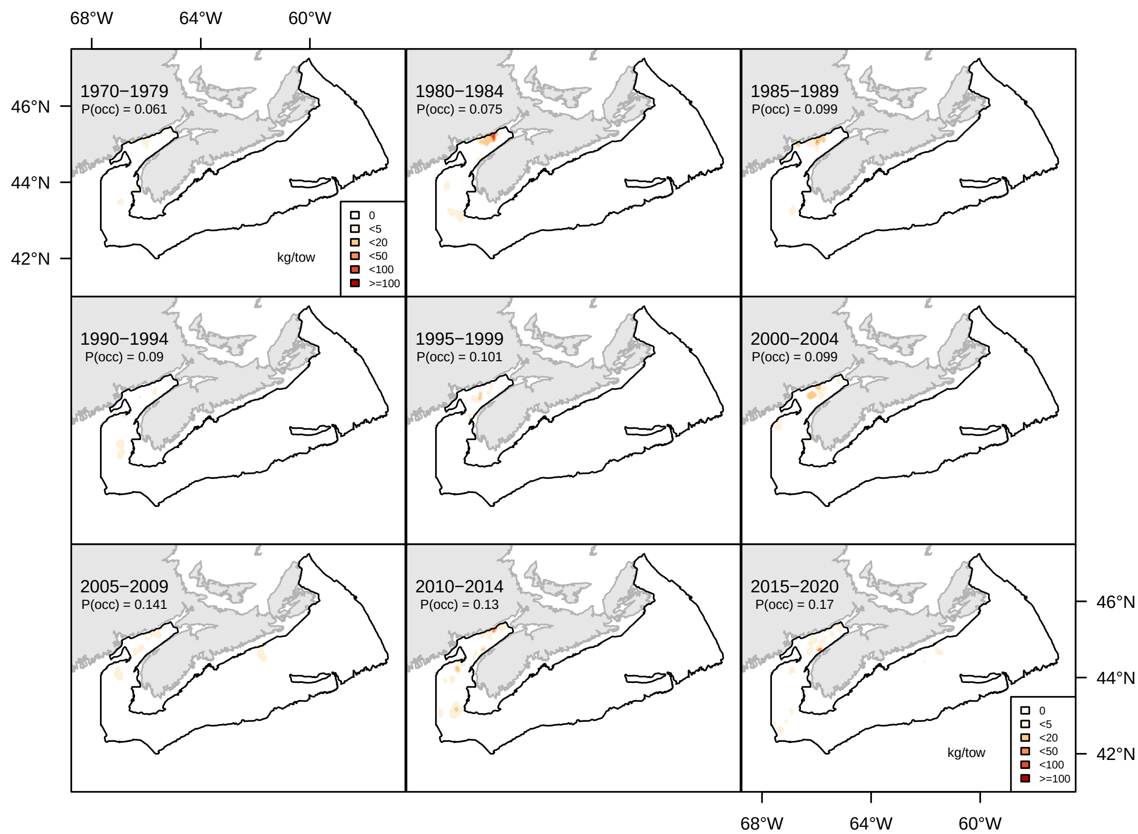



Figure 6.31A. Inverse distance weighted distribution of catch biomass (kg/tow) for Alewife.

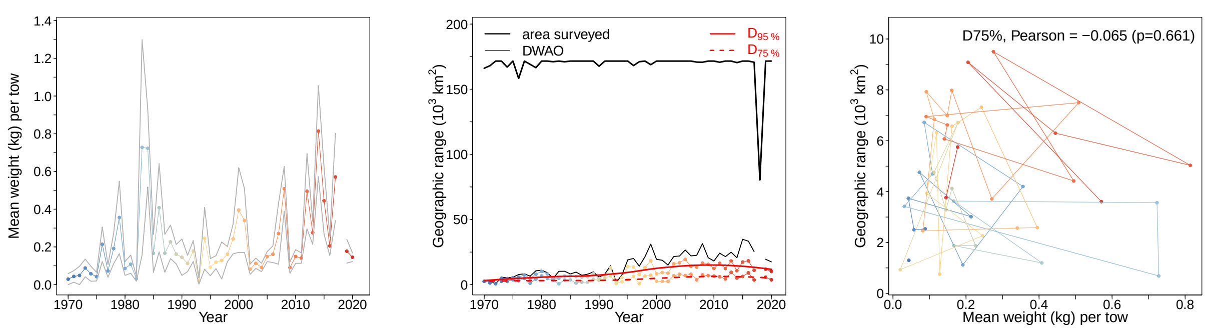



Figure 6.31B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Alewife.

### 6.32 Greater argentine (Grande argentine) - species code 160 (category LI)

Scientific name: Argentina silus

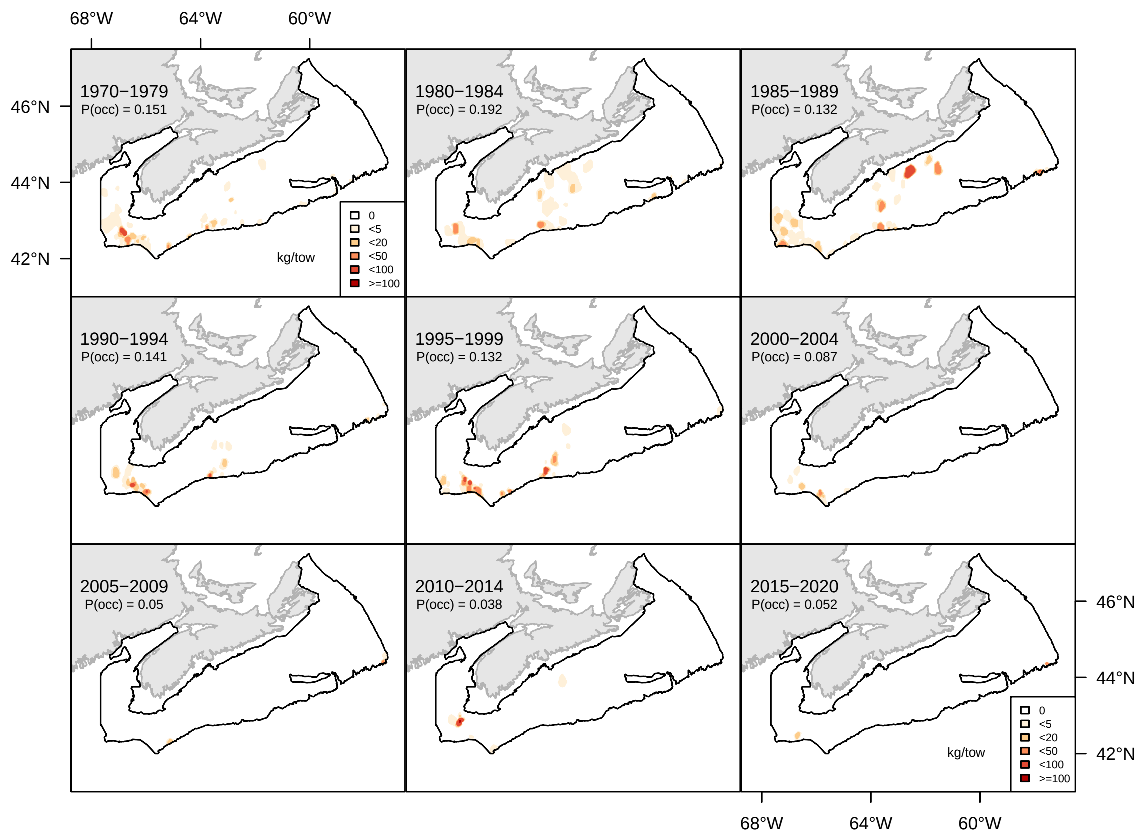



Figure 6.32A. Inverse distance weighted distribution of catch biomass (kg/tow) for Greater argentine.

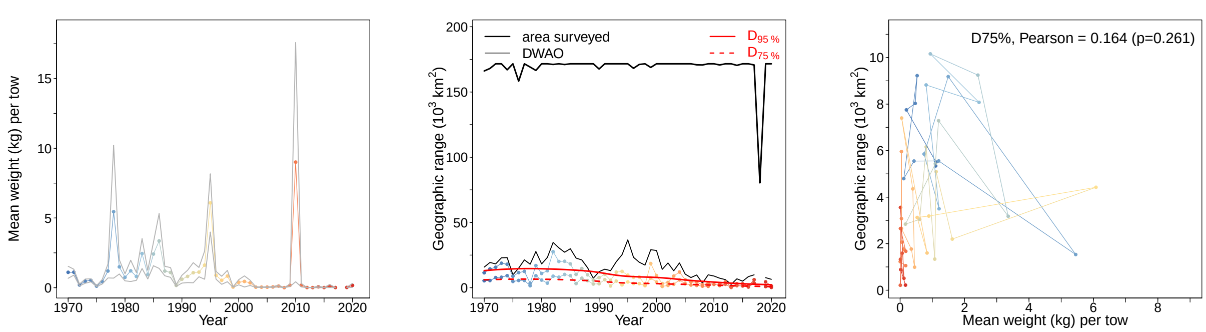



Figure 6.32B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Greater argentine.

## 6.33 Barndoor skate (Grande raie) - species code 200 (category LI)

Scientific name: Dipturus laevis

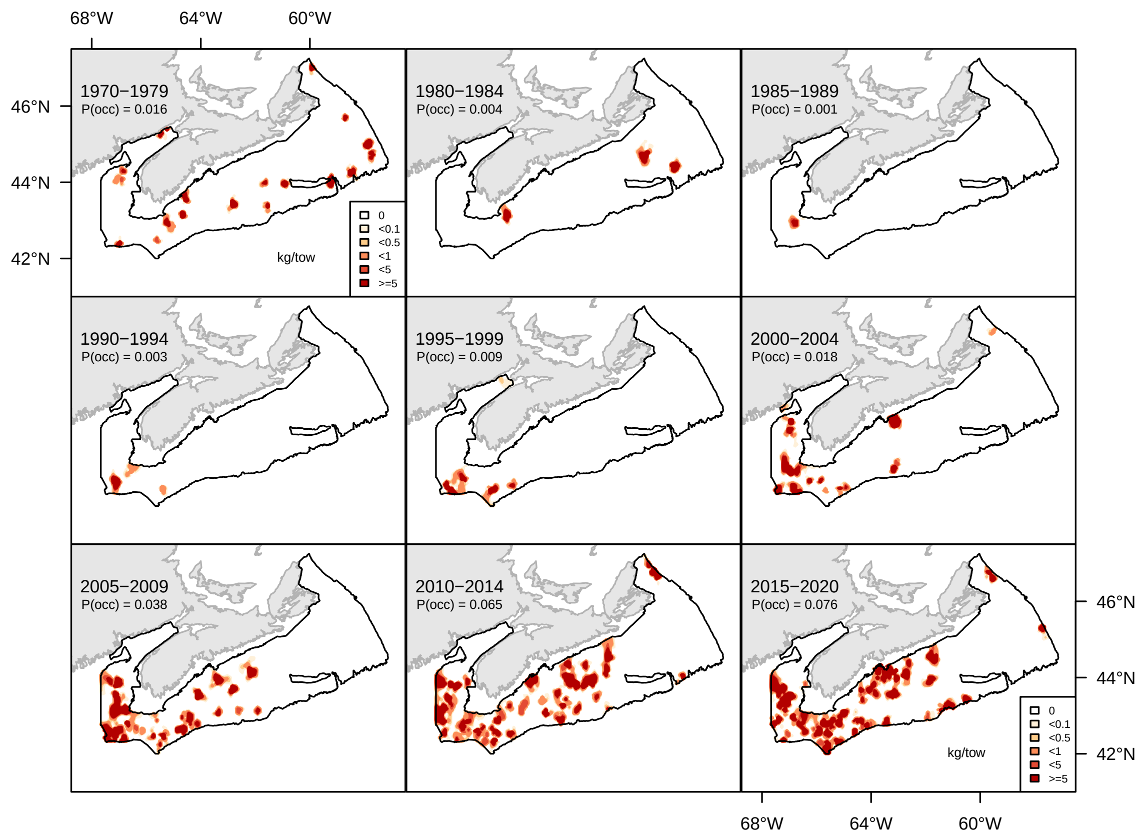



Figure 6.33A. Inverse distance weighted distribution of catch biomass (kg/tow) for Barndoor skate.

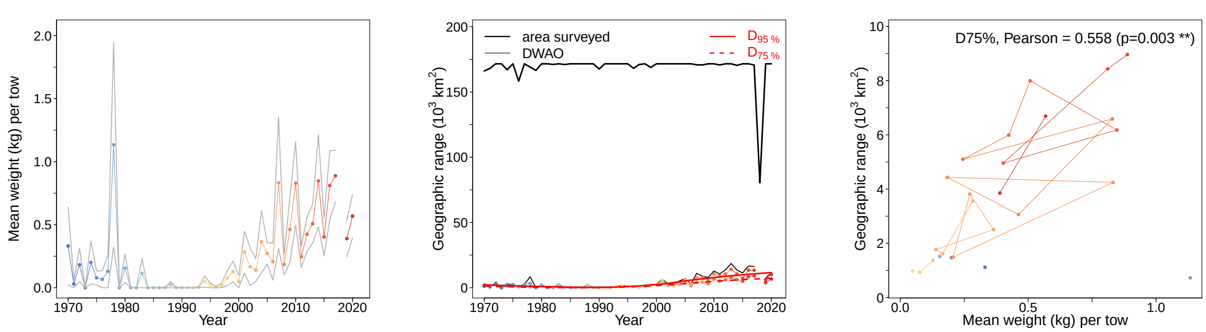



Figure 6.33B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Barndoor skate.

## 6.34 Little skate (Raie hérisson) - species code 203 (category LI)

Scientific name: [Leucoraja erinacea]

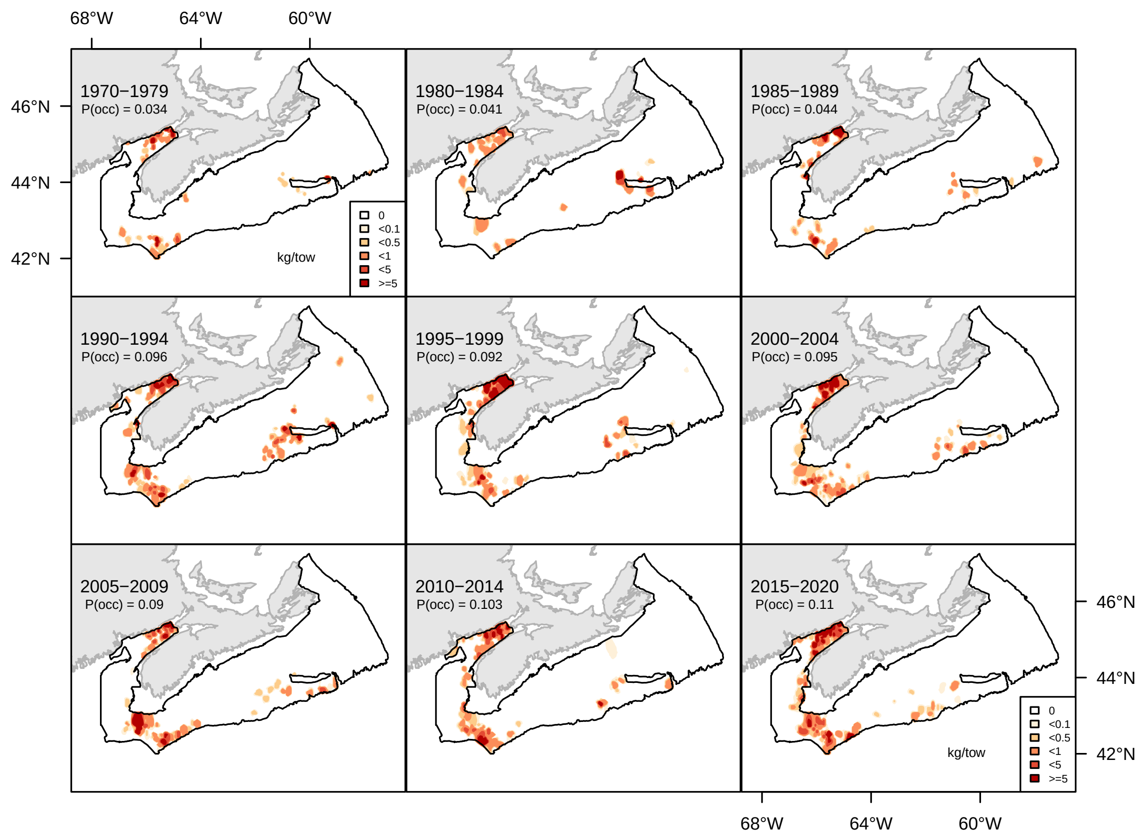



Figure 6.34A. Inverse distance weighted distribution of catch biomass (kg/tow) for Little skate.

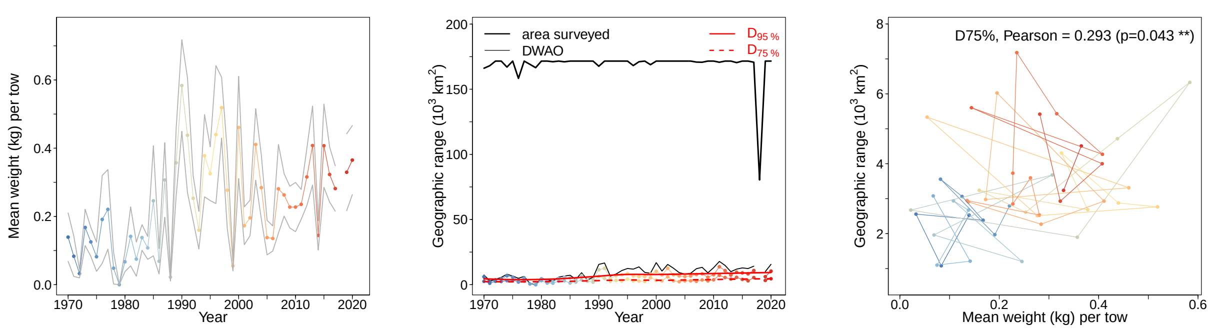



Figure 6.34B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Little skate.

## 6.35 Winter skate (Raie tachetée) - species code 204 (category LI)

Scientific name: Leucoraja ocellata

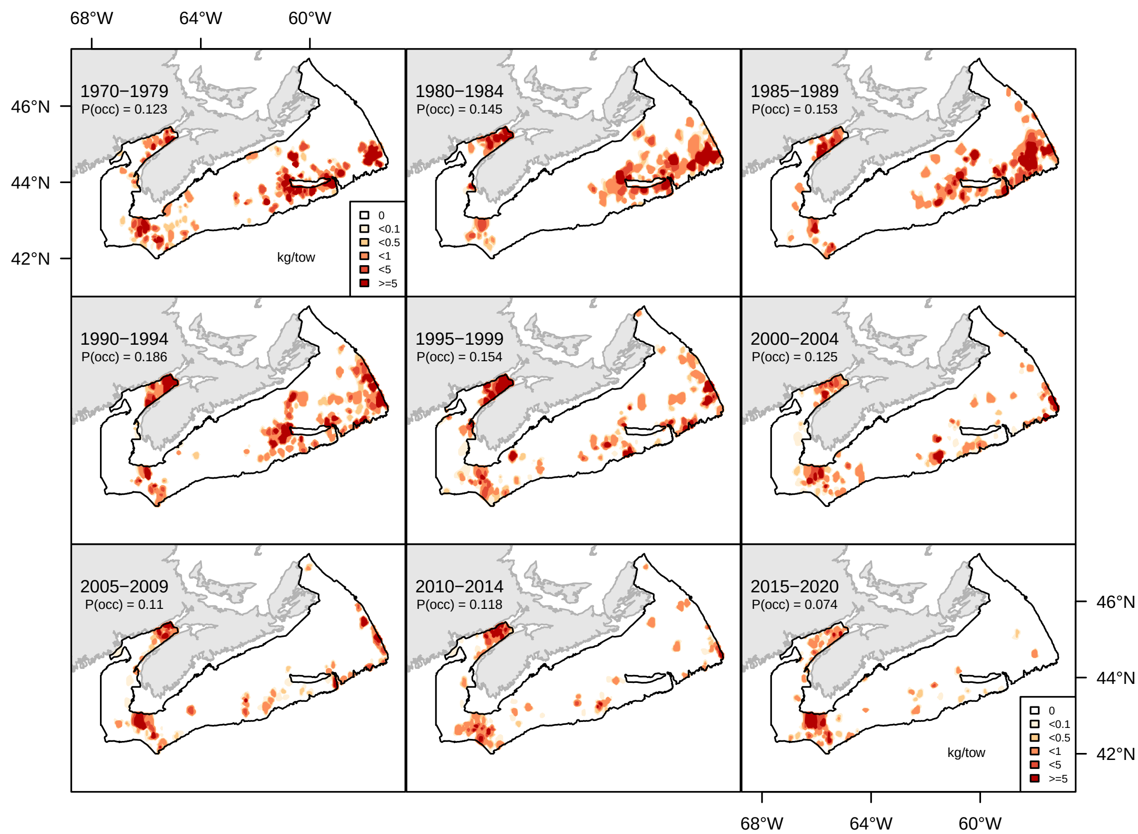



Figure 6.35A. Inverse distance weighted distribution of catch biomass (kg/tow) for Winter skate.

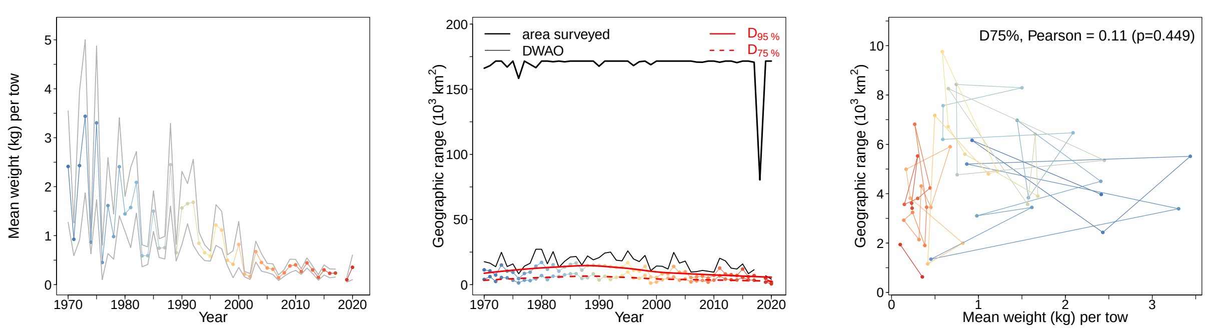



Figure 6.35B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Winter skate.

### 6.36 Atlantic mackerel (Maquereau commun) - species code 70 (category LI)

Scientific name: Scomber scombrus

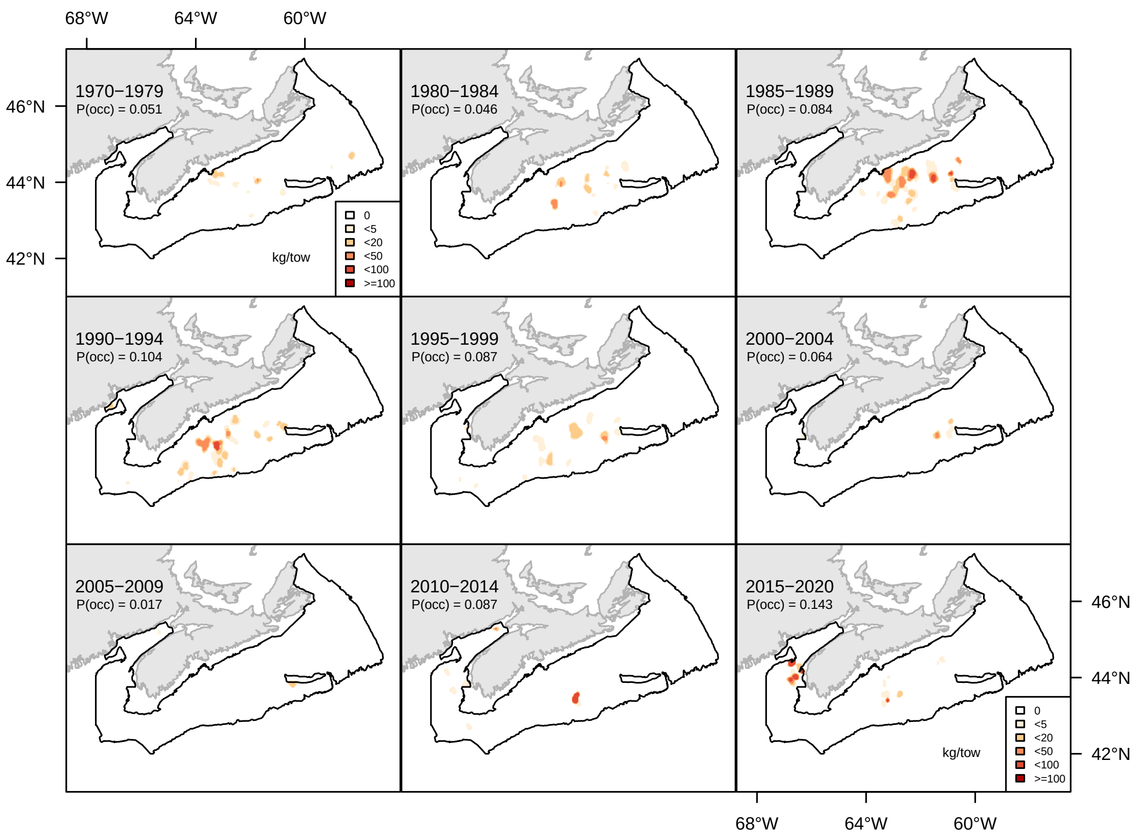



Figure 6.36A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic mackerel.

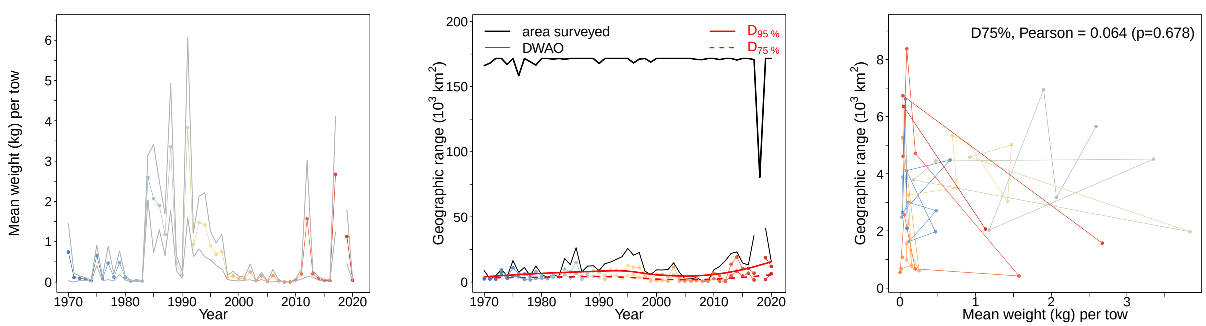



Figure 6.36B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic mackerel.

## 6.37 Fourbeard rockling (Motelle à 4 barbillons) - species code 114 (category LIn)

Scientific name: Enchelyopus cimbrius

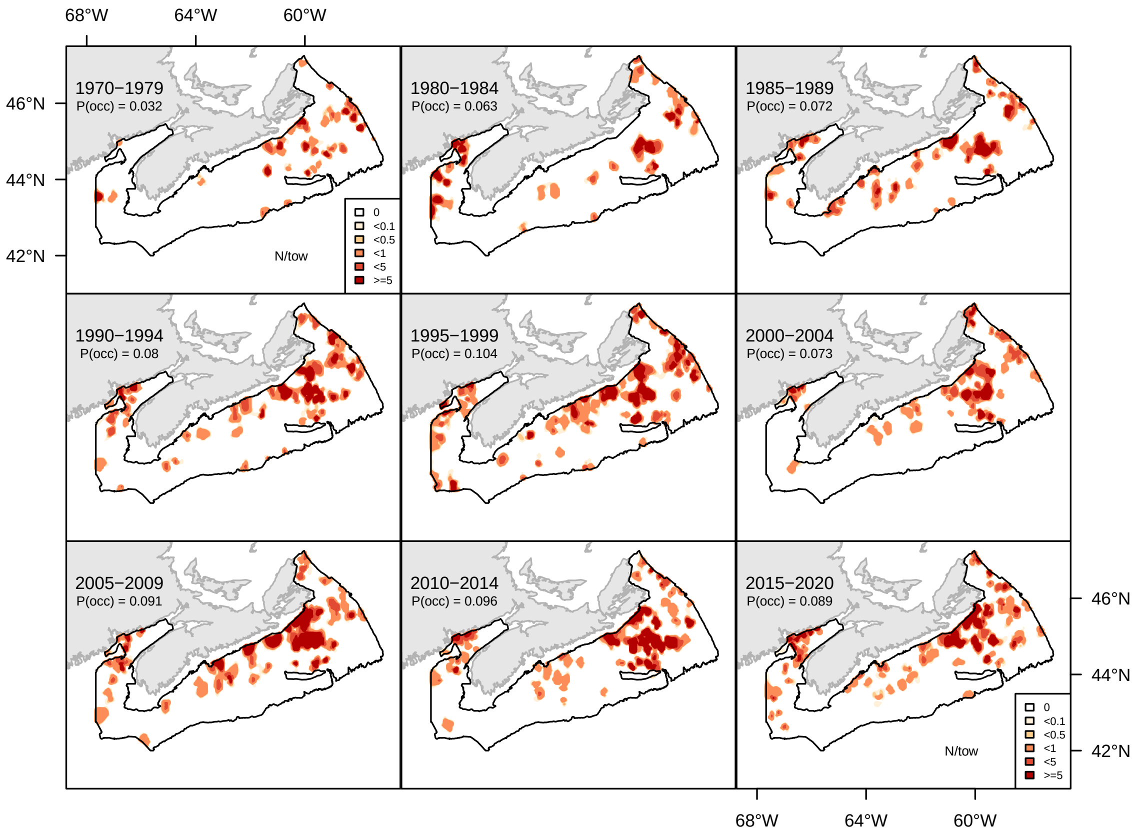



Figure 6.37A. Inverse distance weighted distribution of catch abundance (N/tow) for Fourbeard rockling.

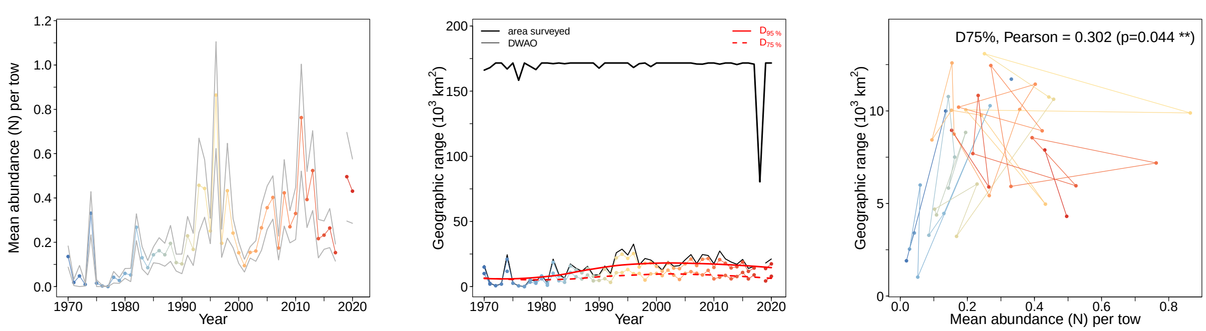



Figure 6.37B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Fourbeard rockling.

## 6.38 Greenland halibut (Flétan du Groënland) - species code 31 (category LIn)

Scientific name: Reinhardtius hippoglossoides

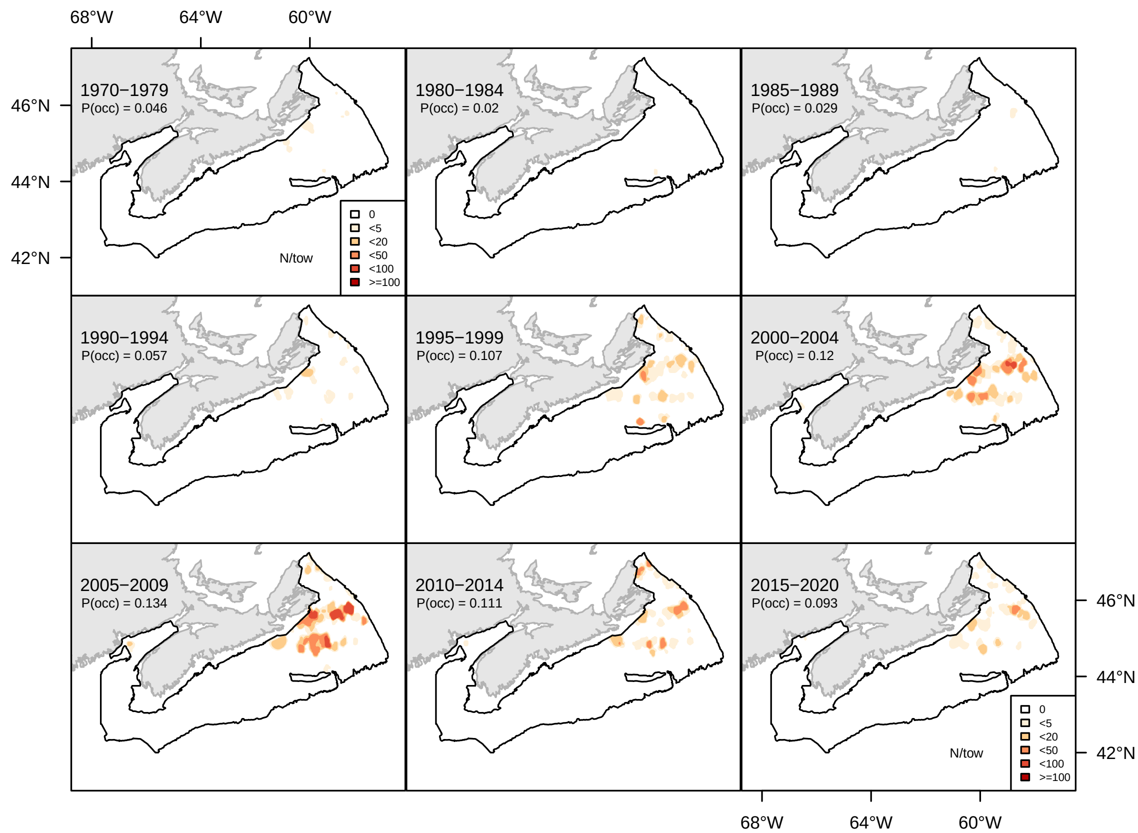



Figure 6.38A. Inverse distance weighted distribution of catch abundance (N/tow) for Greenland halibut.

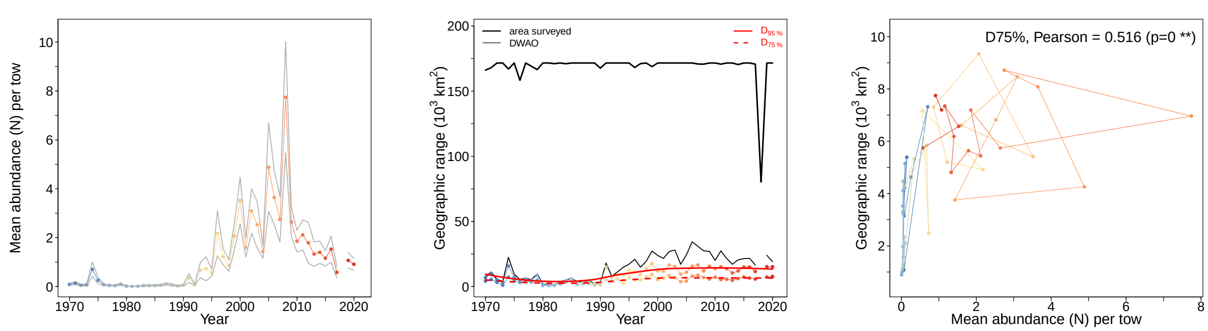



Figure 6.38B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Greenland halibut.

## 6.39 Gulf Stream flounder (Plie du Gulf Stream) - species code 44 (category LIn)

Scientific name: [Citharichthys arctifrons]

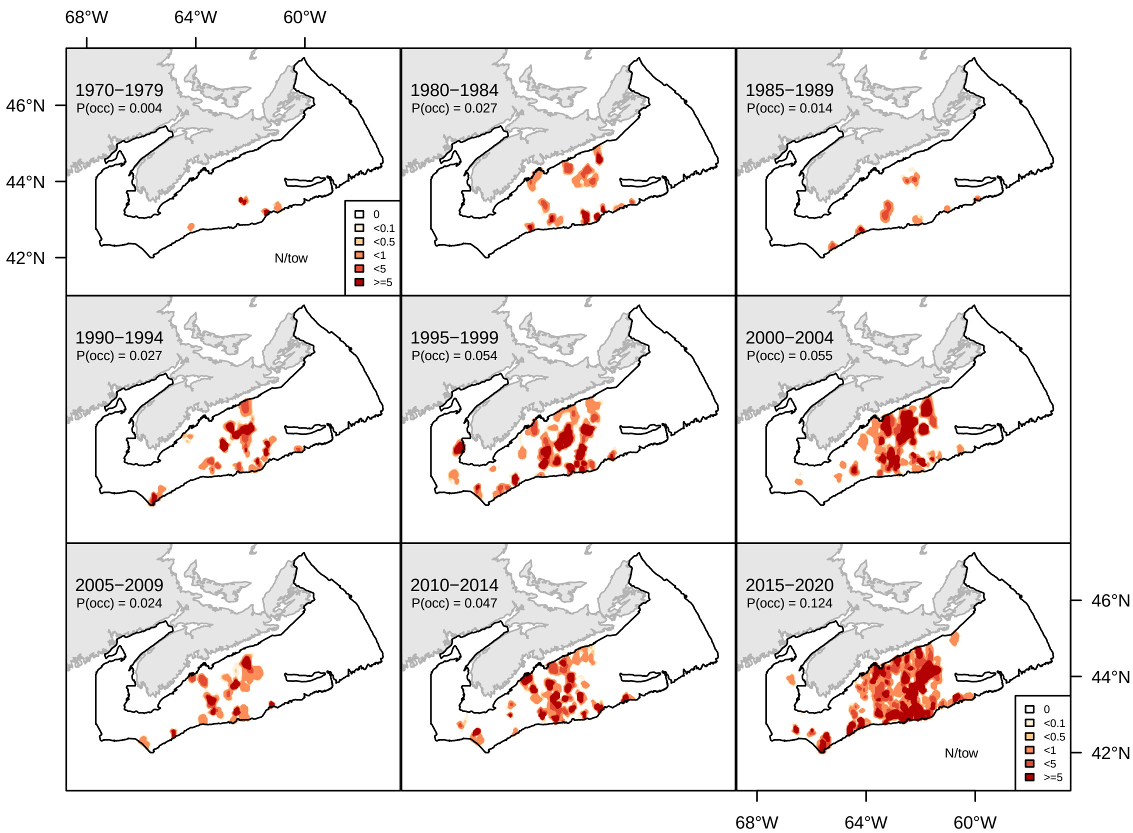



Figure 6.39A. Inverse distance weighted distribution of catch abundance (N/tow) for Gulf Stream flounder.

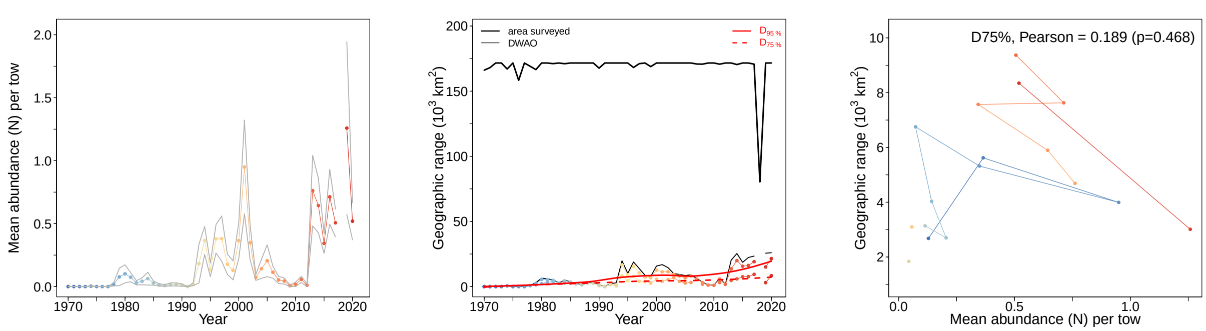



Figure 6.39B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Gulf Stream flounder.

## 6.40 Blackbelly rosefish (Sébaste chèvre) - species code 123 (category LIn)

Scientific name: Helicolenus dactylopterus

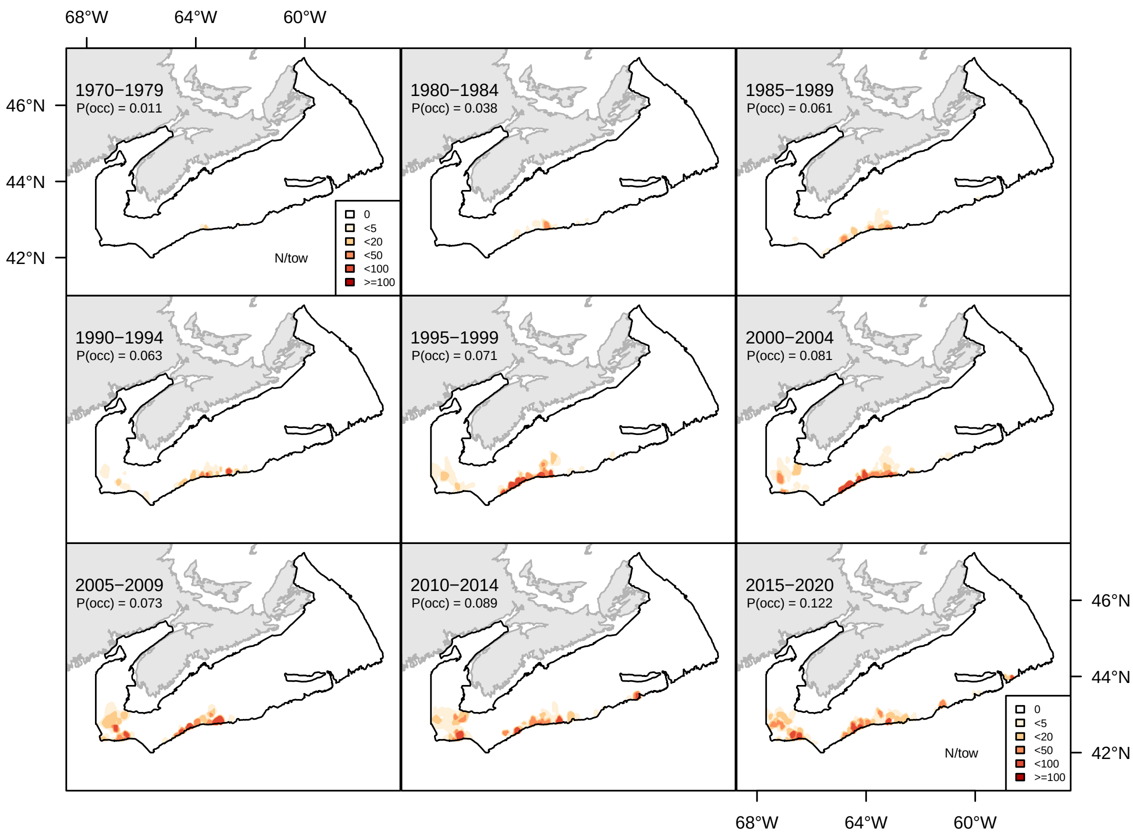



Figure 6.40A. Inverse distance weighted distribution of catch abundance (N/tow) for Blackbelly rosefish.

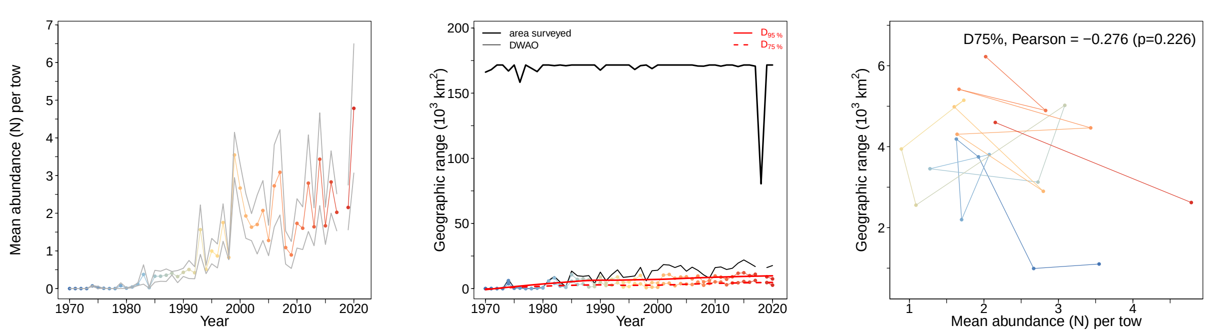



Figure 6.40B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Blackbelly rosefish.

## 6.41 Arctic hookear sculpin (Hameçon neigeux) - species code 306 (category LIn)

Scientific name: Artediellus uncinatus

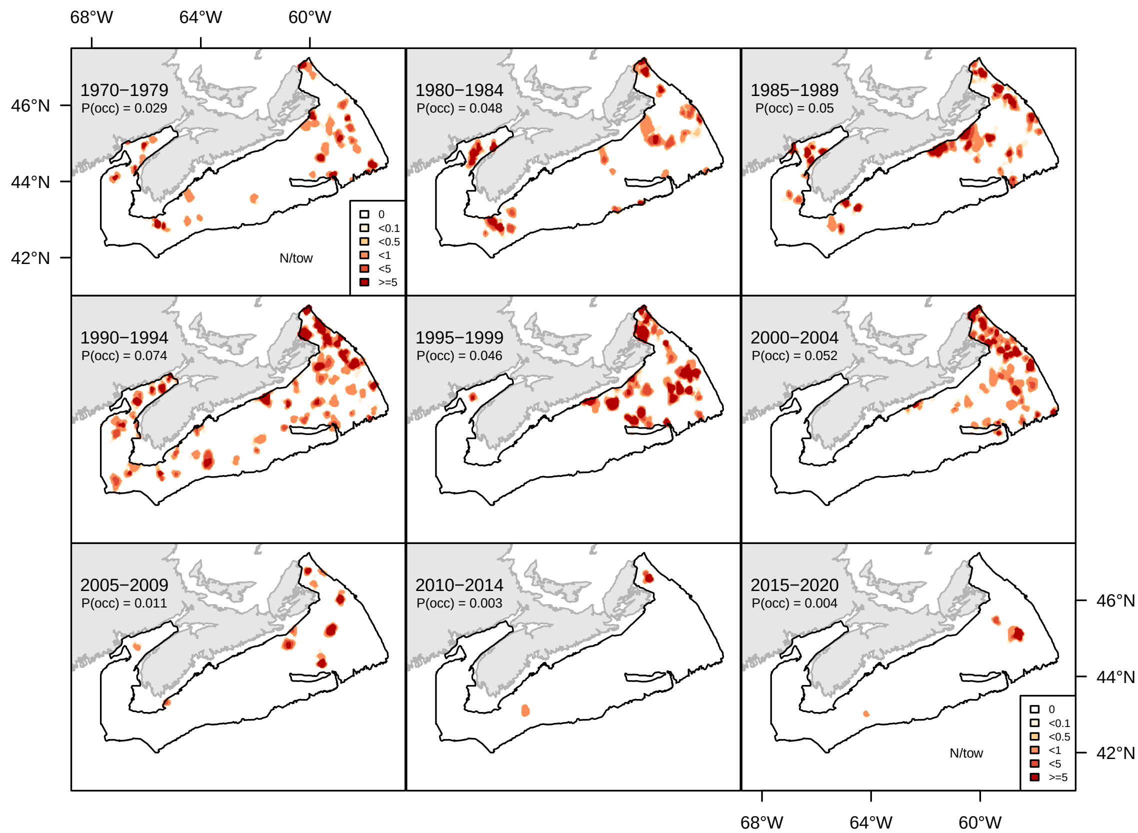



Figure 6.41A. Inverse distance weighted distribution of catch abundance (N/tow) for Arctic hookear sculpin.

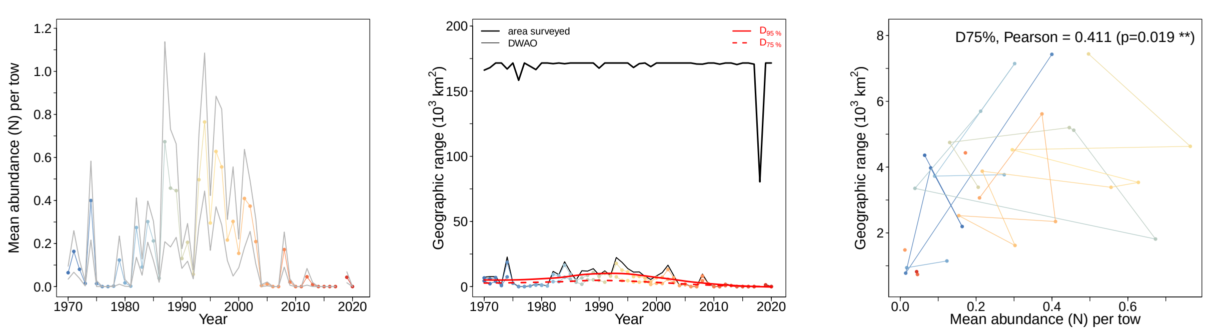



Figure 6.41B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Arctic hookear sculpin.

## 6.42 Alligatorfish (Poisson-alligator atlantique) - species code 340 (category LIn)

Scientific name: [Aspidophoroides monopterygius]

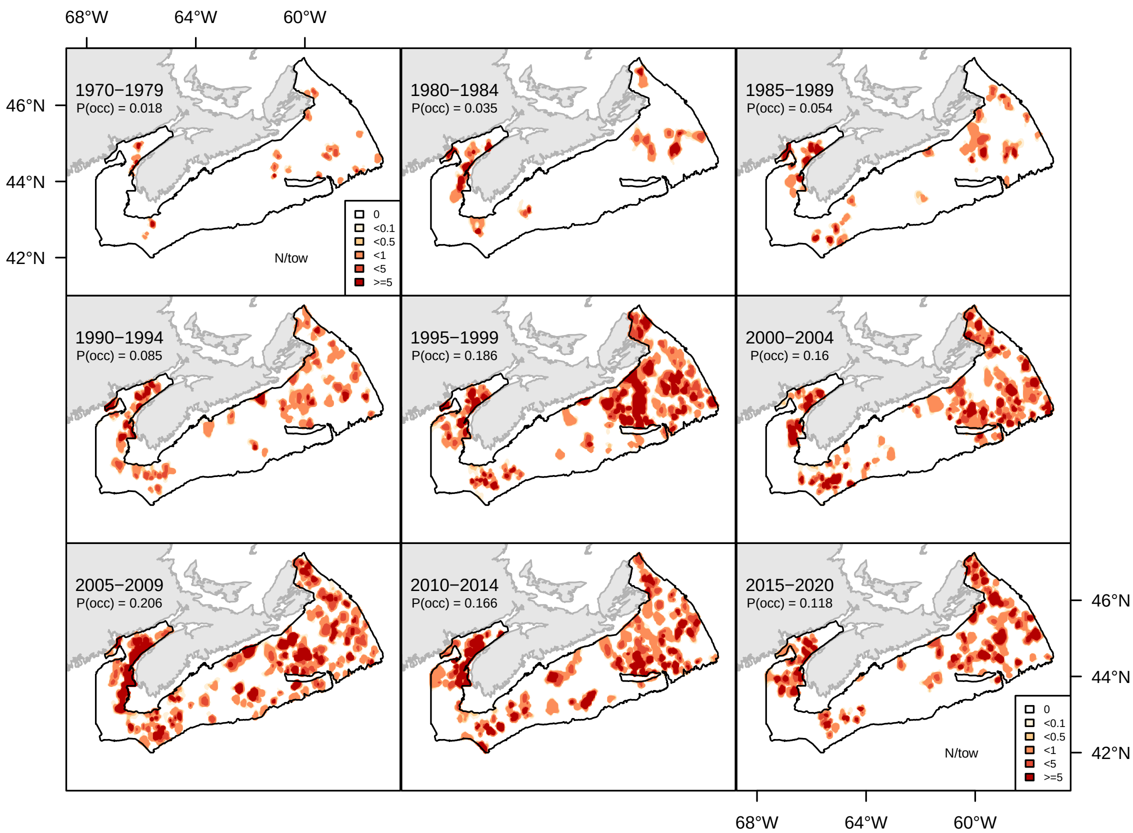



Figure 6.42A. Inverse distance weighted distribution of catch abundance (N/tow) for Alligatorfish.

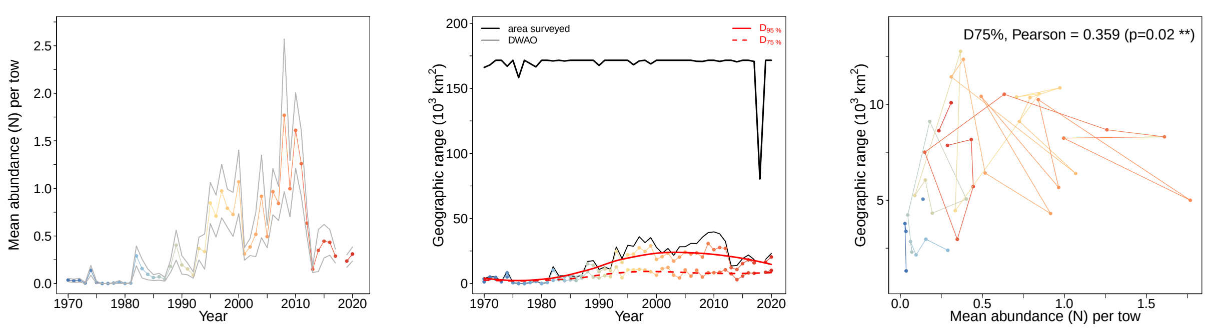



Figure 6.42B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Alligatorfish.

## 6.43 Atlantic poacher (Agone atlantique) - species code 350 (category LIn)

Scientific name: Leptagonus decagonus

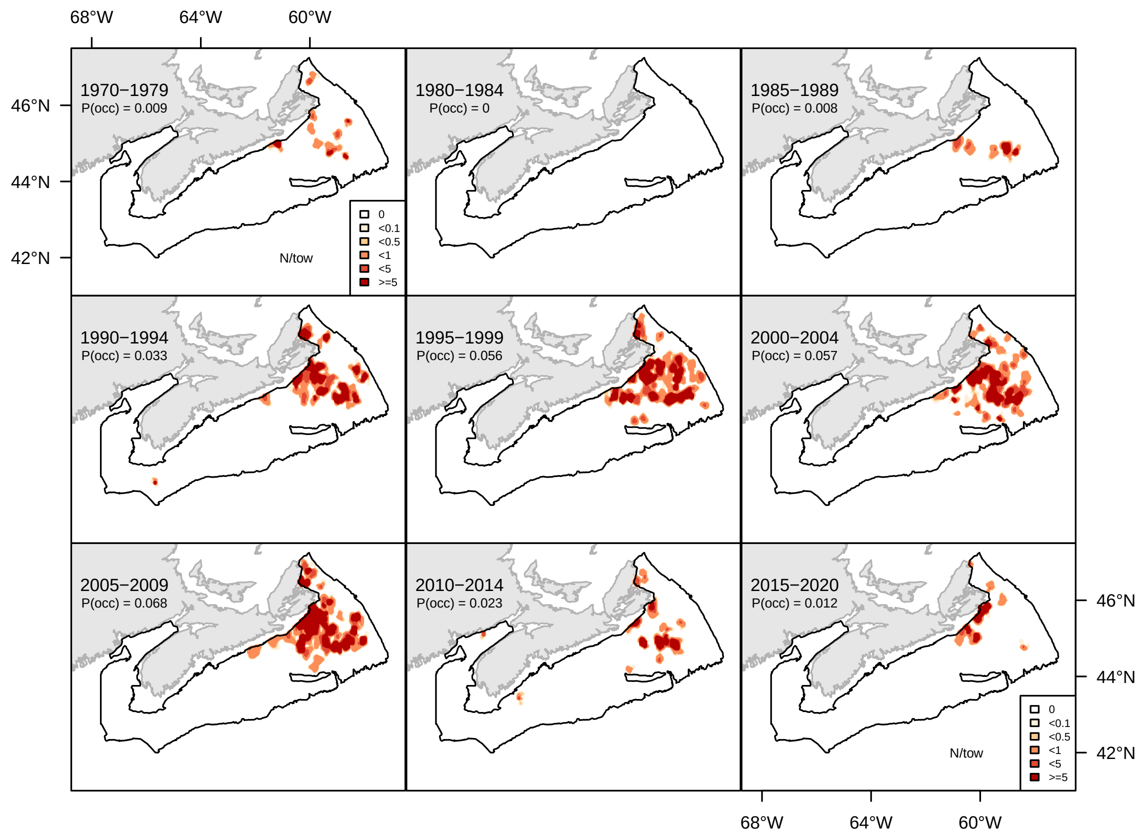



Figure 6.43A. Inverse distance weighted distribution of catch abundance (N/tow) for Atlantic poacher.

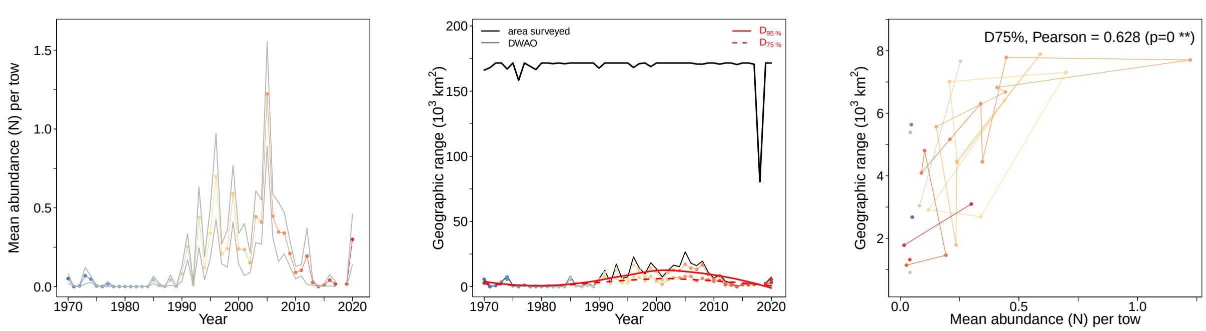



Figure 6.43B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic poacher.

### 6.44 Atl. spiny lumpsucker (Petite poule de mer atl.) - species code 502 (category LIn)

Scientific name: [Eumicrotremus spinosus]

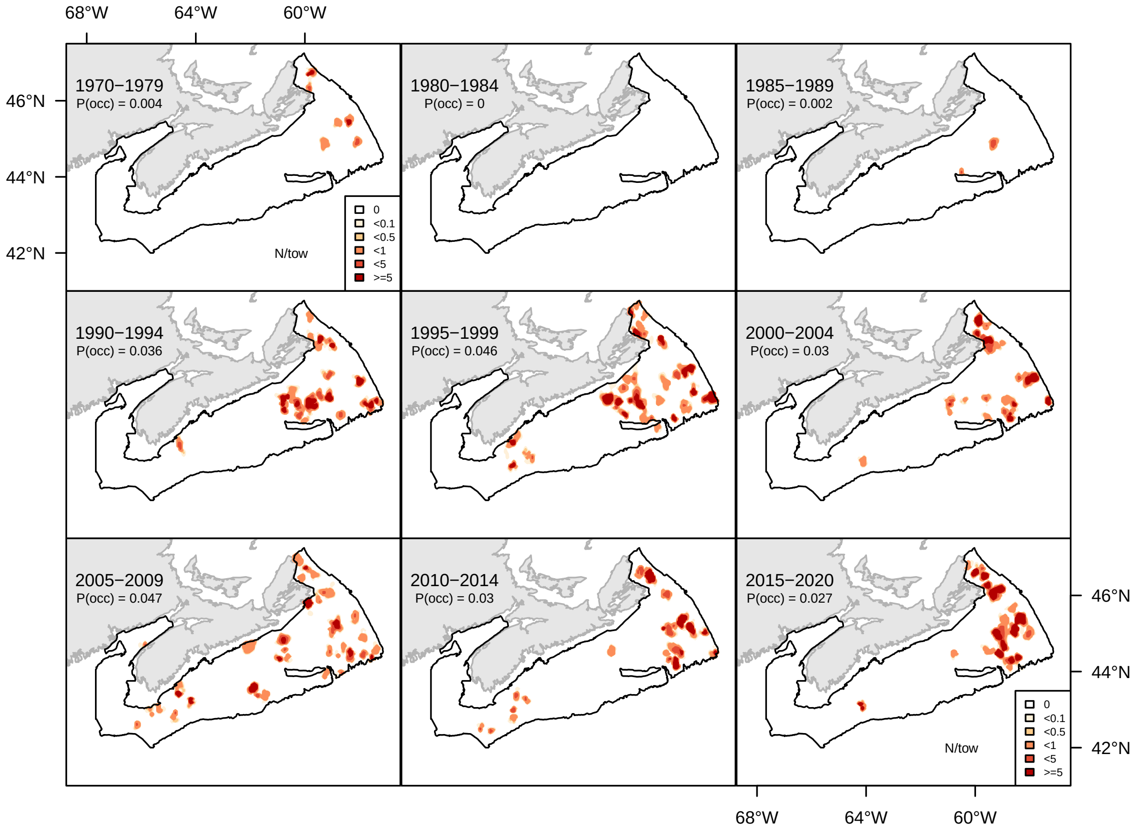



Figure 6.44A. Inverse distance weighted distribution of catch abundance (N/tow) for Atl. spiny lumpsucker.

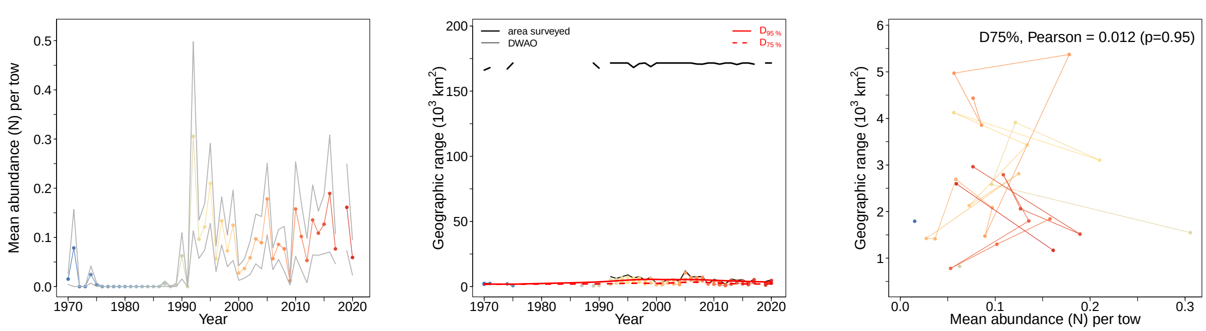



Figure 6.44B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atl. spiny lumpsucker.

## 6.45 Sand lance (Lançon) - species code 610 (category LIn)

Scientific name: Ammodytes dubius

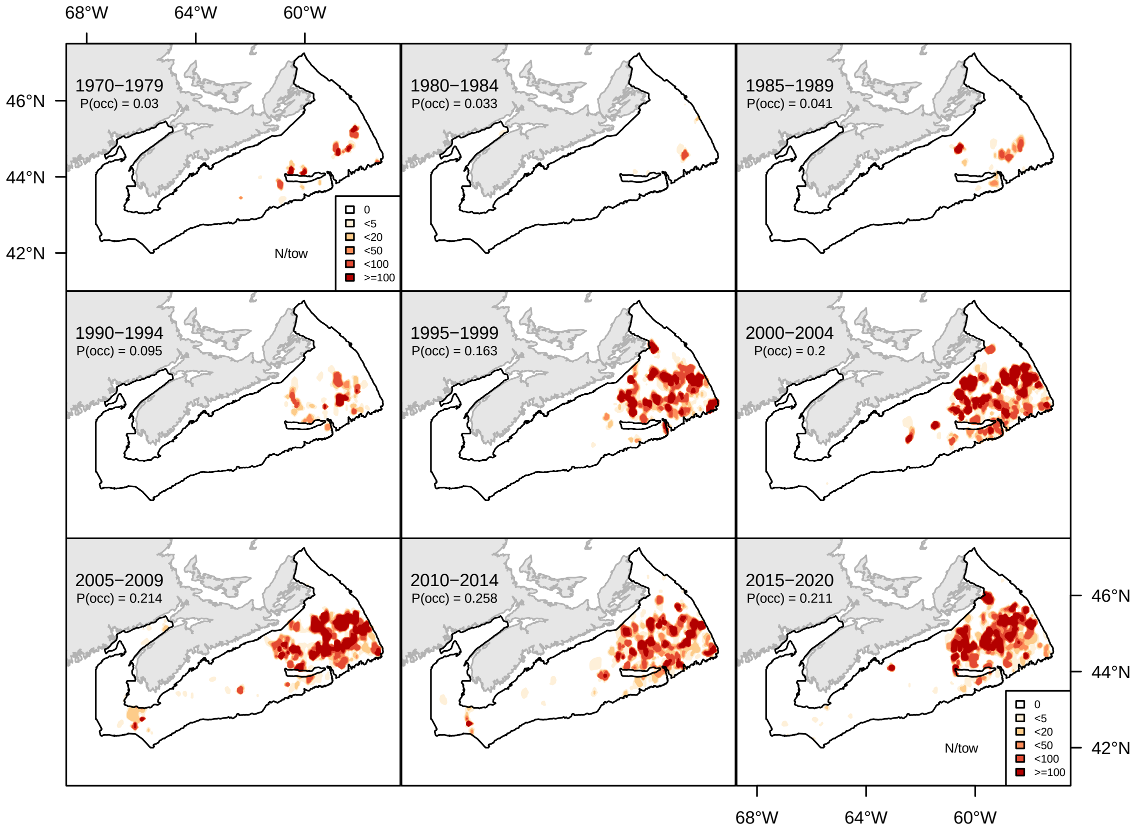



Figure 6.45A. Inverse distance weighted distribution of catch abundance (N/tow) for Sand lance.

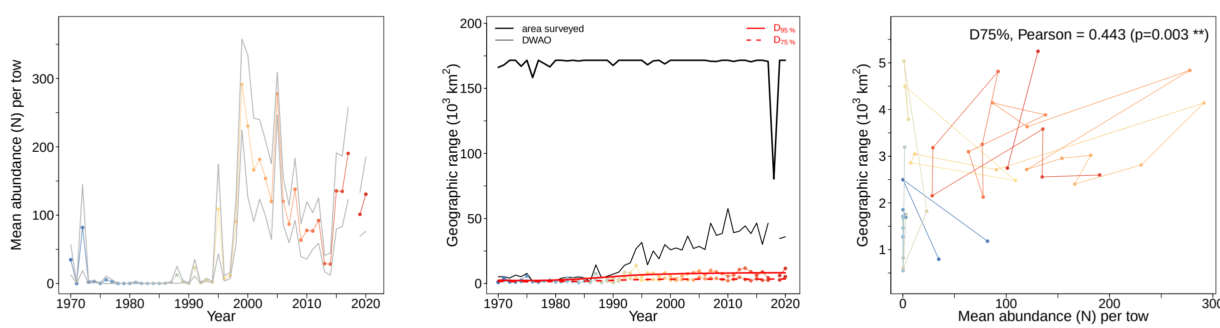



Figure 6.45B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Sand lance.

### 6.46 Snakeblenny (Lompénie-serpent) - species code 622 (category LIn)

Scientific name: Lumpenus lampretaeformis

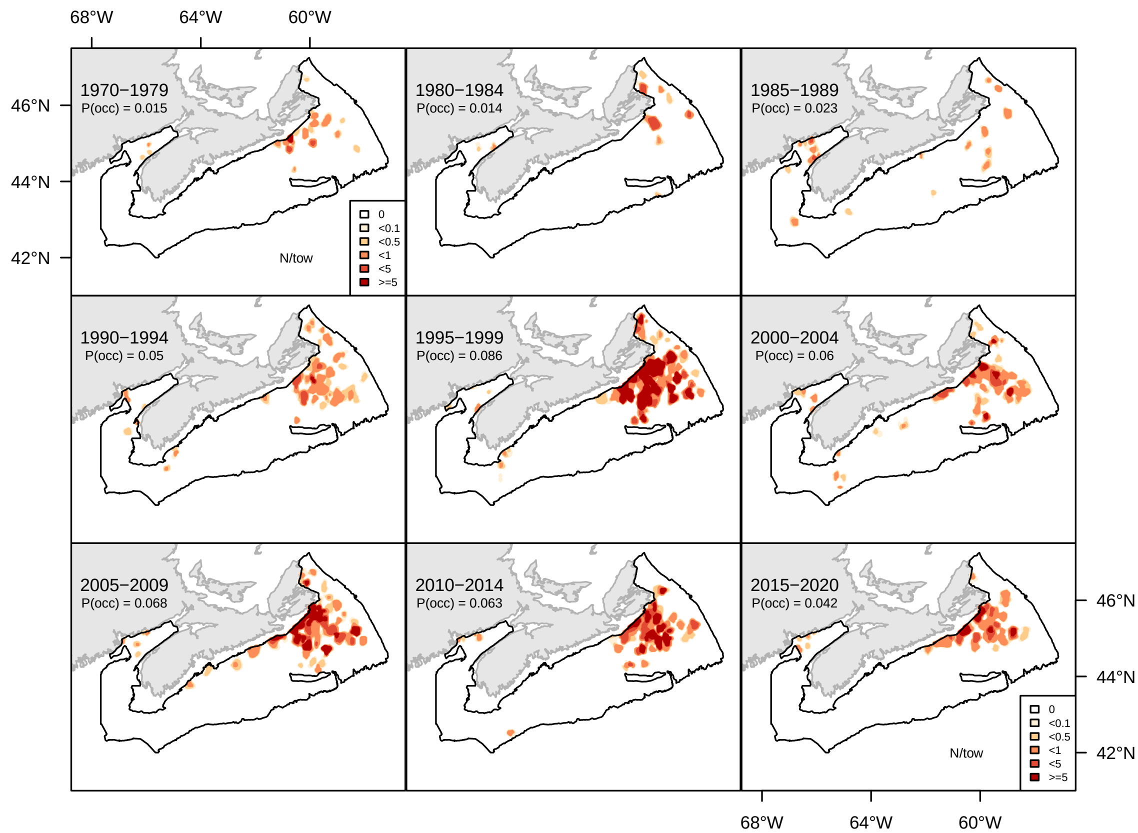


Figure 6.46A. Inverse distance weighted distribution of catch abundance (N/tow) for Snakeblenny.

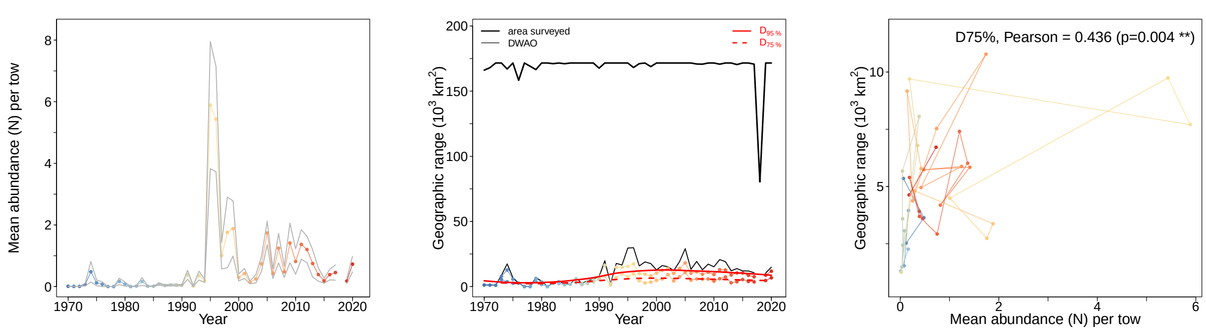


Figure 6.46B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Snakeblenny.

## 6.47 Daubed shanny (Lompénie tachetée) - species code 623 (category LIn)

Scientific name: Leptoclinus maculatus

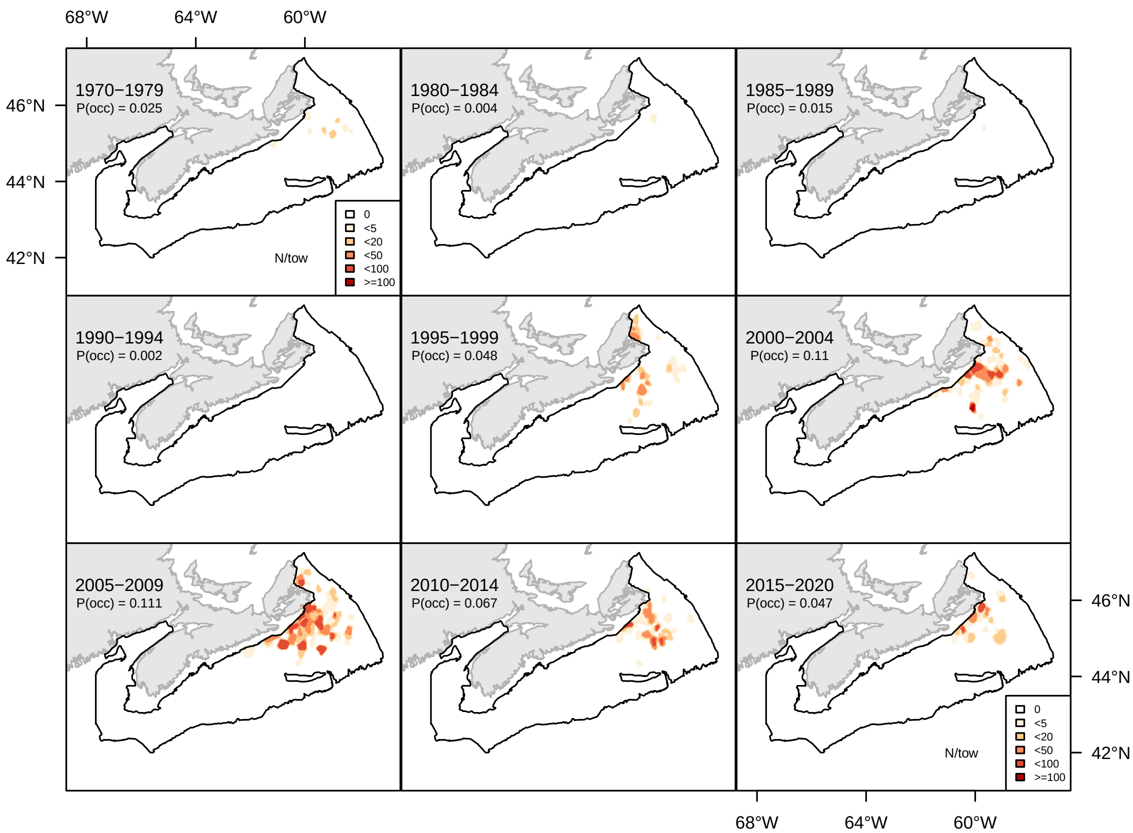



Figure 6.47A. Inverse distance weighted distribution of catch abundance (N/tow) for Daubed shanny.

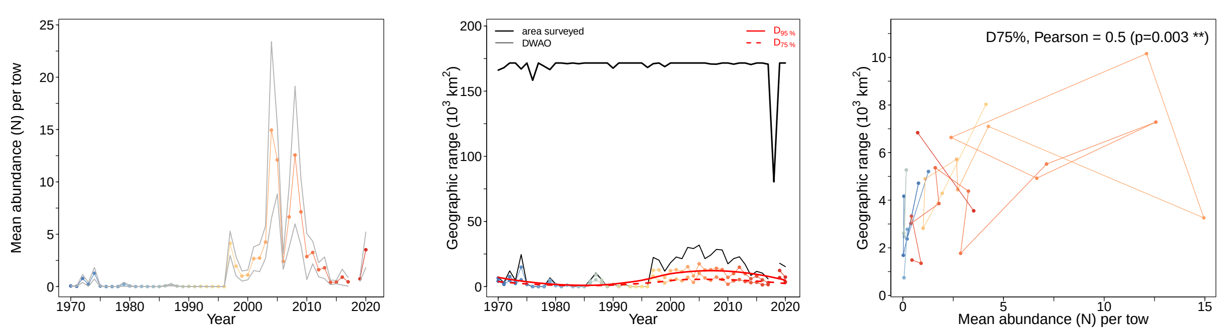



Figure 6.47B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Daubed shanny.

## 6.48 Atlantic butterfish (Stromatée à fossettes) - species code 701 (category LIn)

Scientific name: [Peprilus triacanthus]

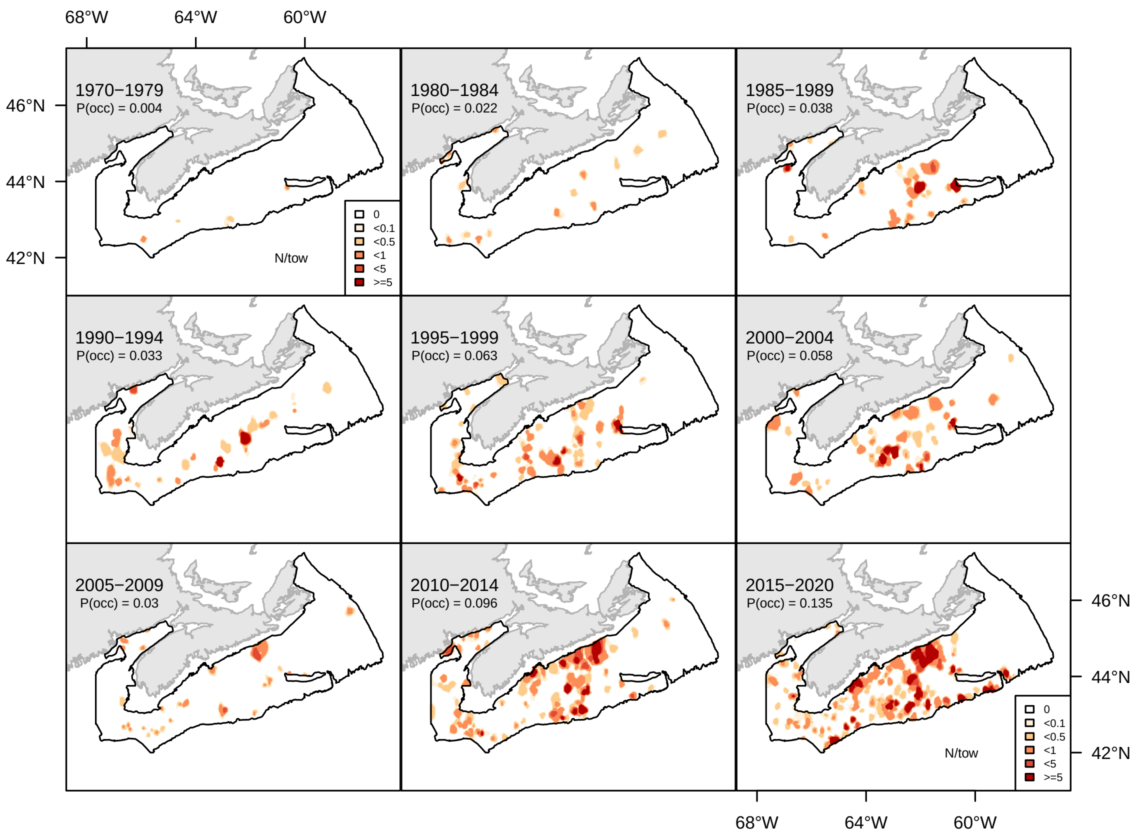



Figure 6.48A. Inverse distance weighted distribution of catch abundance (N/tow) for Atlantic butterfish.

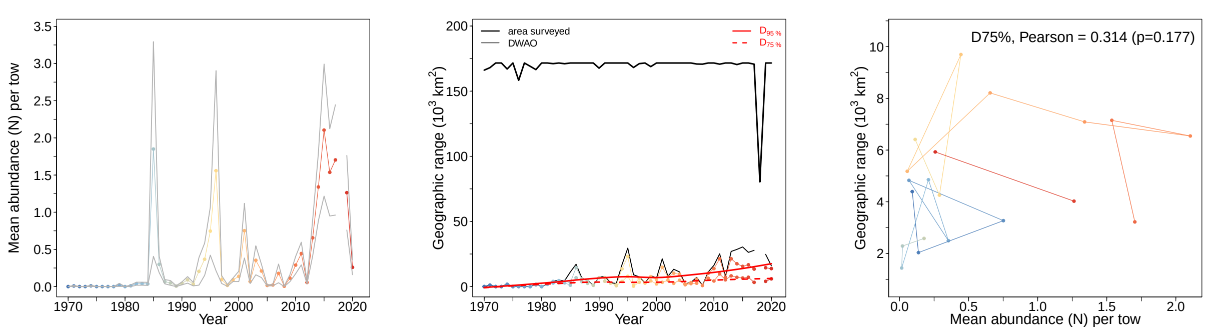



Figure 6.48B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic butterfish.

### 6.49 Atlantic hookear sculpin (Hameçon atlantique) - species code 880 (category LIn)

Scientific name: [Artediellus atlanticus]

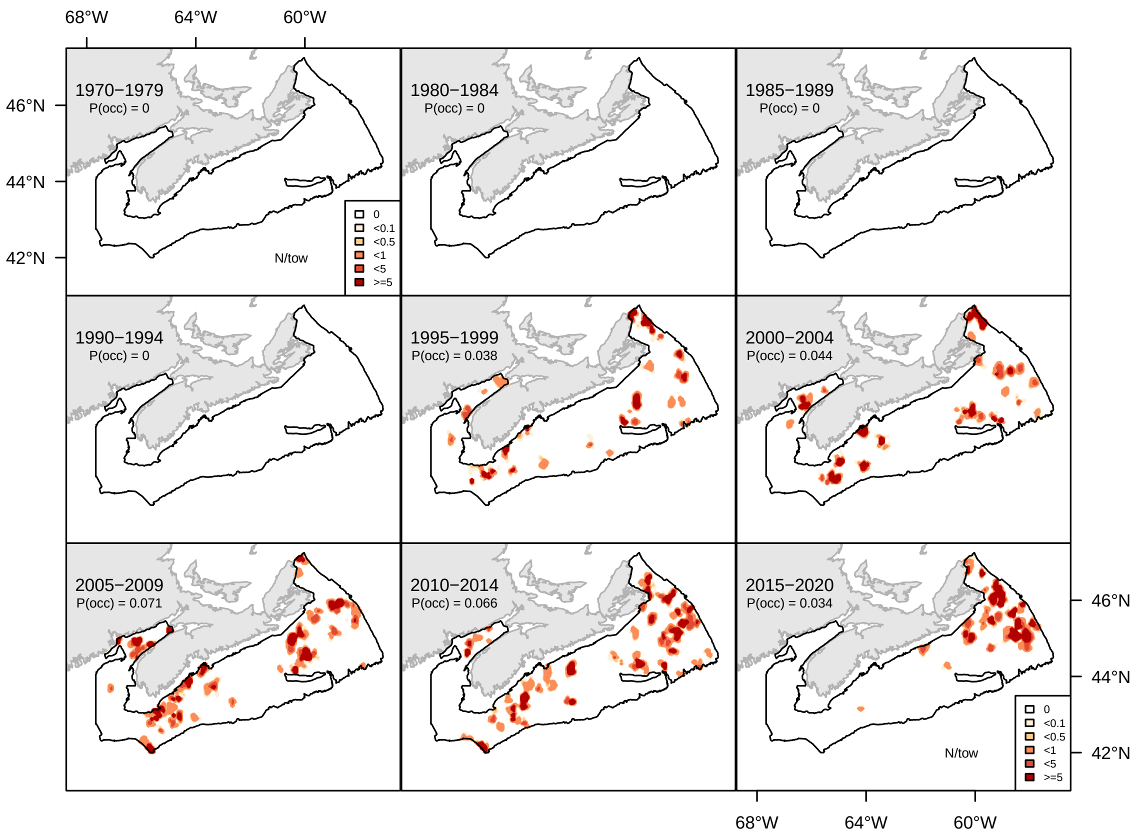



Figure 6.49A. Inverse distance weighted distribution of catch abundance (N/tow) for Atlantic hookear sculpin.

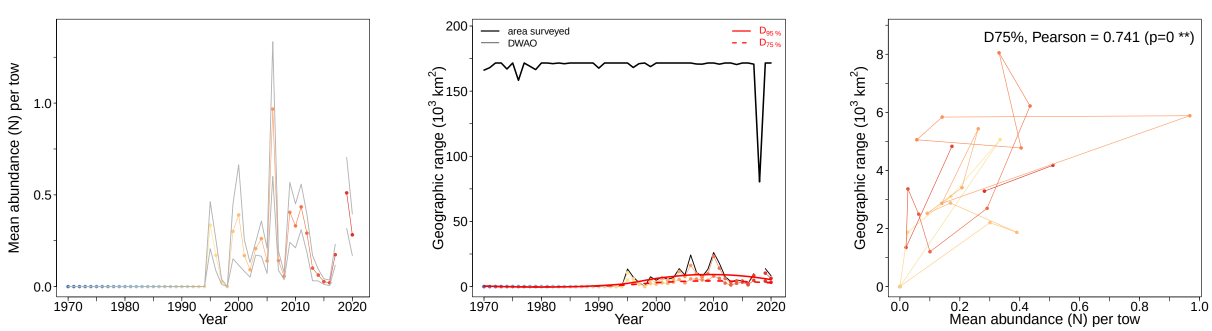



Figure 6.49B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic hookear sculpin.

## 6.50 Capelin (Capelan) - species code 64 (category LIn)

Scientific name: Mallotus villosus

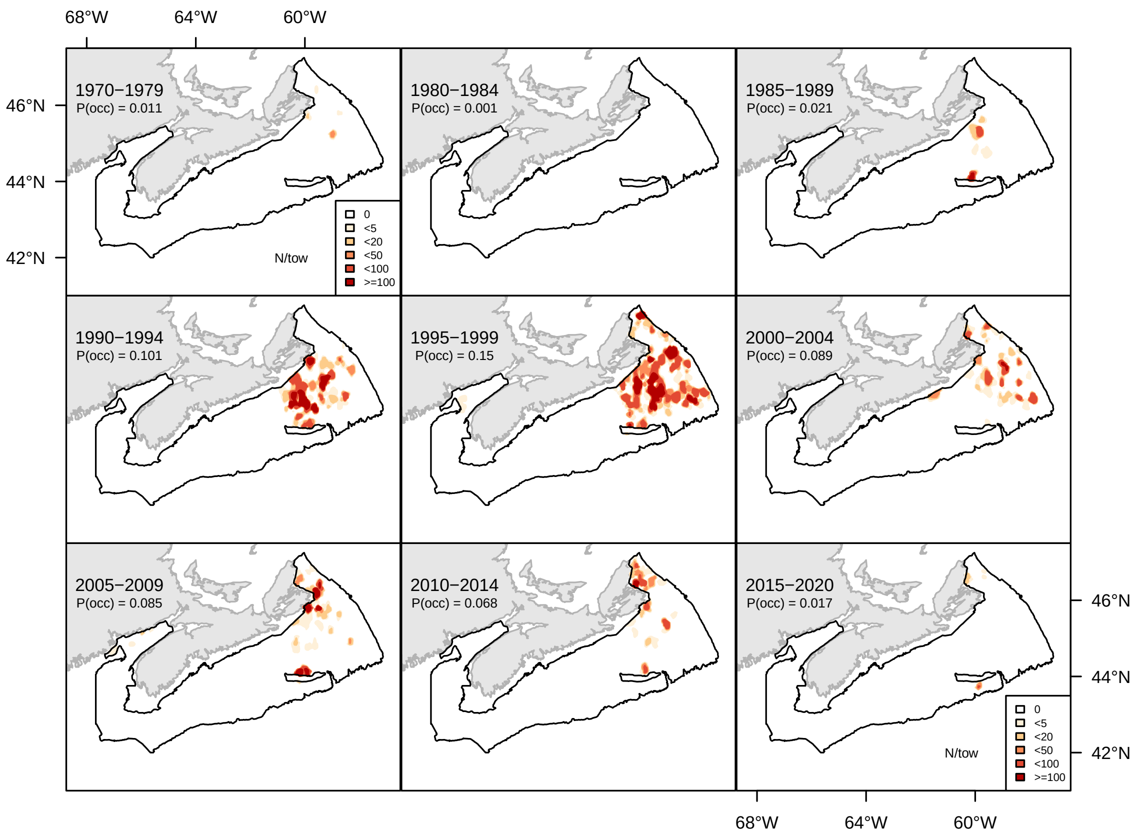



Figure 6.50A. Inverse distance weighted distribution of catch abundance (N/tow) for Capelin.

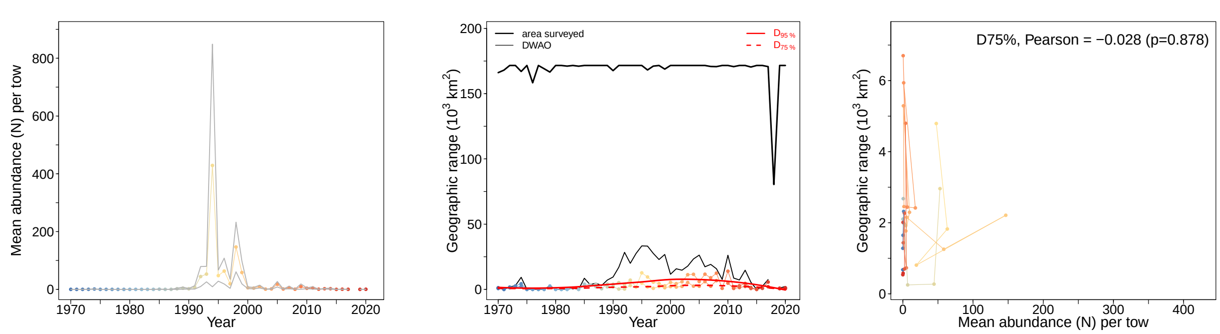



Figure 6.50B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Capelin.

### 6.51 Northern prawn (Crevette nordique) - species code 2211 (category SF)

Scientific name: Pandalus borealis

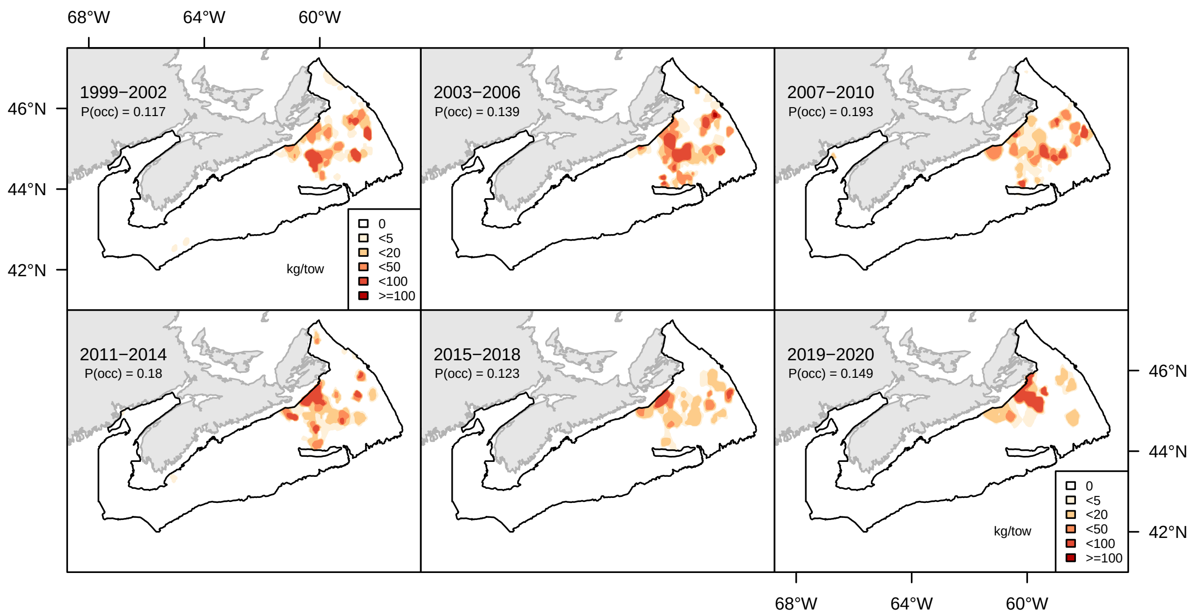



Figure 6.51A. Inverse distance weighted distribution of catch biomass (kg/tow) for Northern prawn.

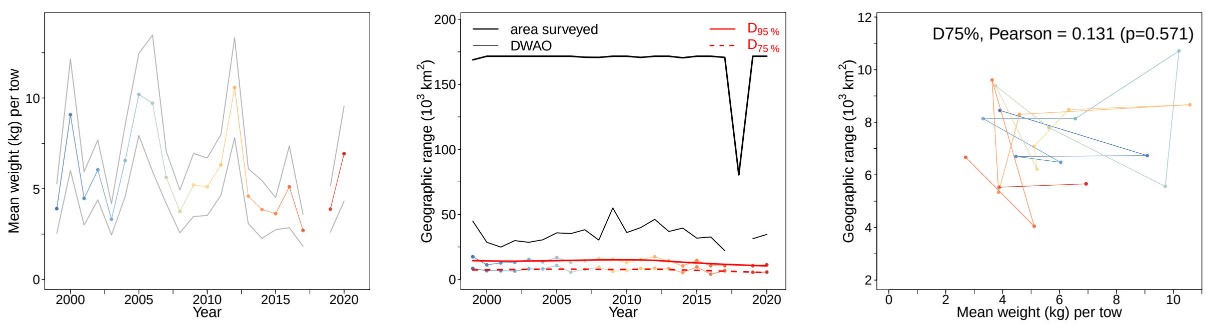



Figure 6.51B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Northern prawn.

## 6.52 Jonah crab (Crabe nordique) - species code 2511 (category SF)

Scientific name: Cancer borealis

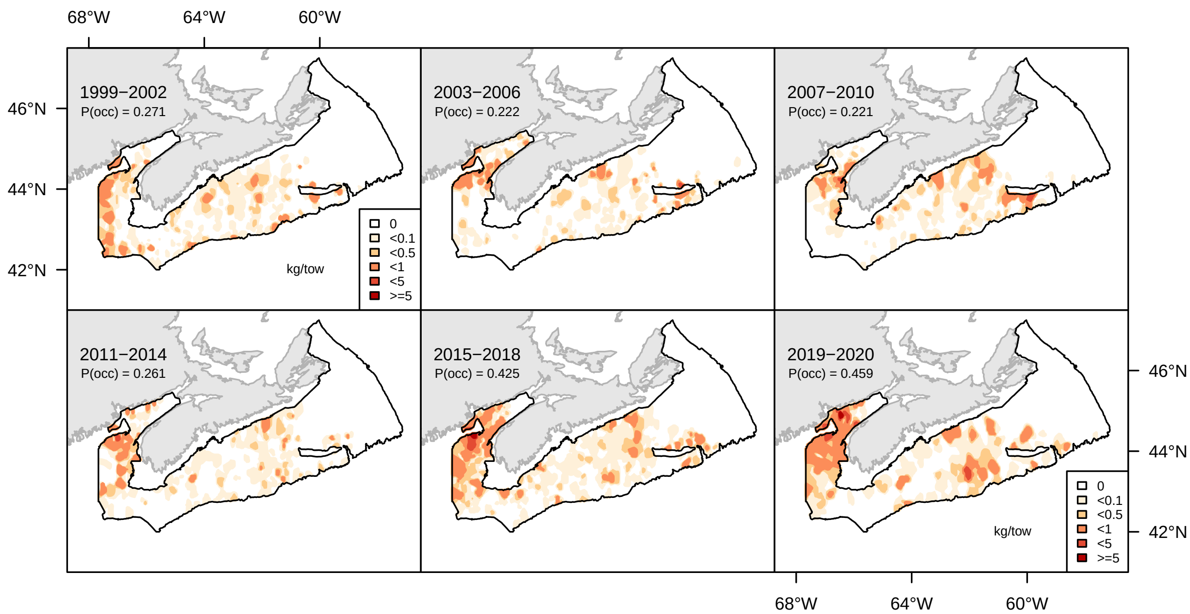



Figure 6.52A. Inverse distance weighted distribution of catch biomass (kg/tow) for Jonah crab.

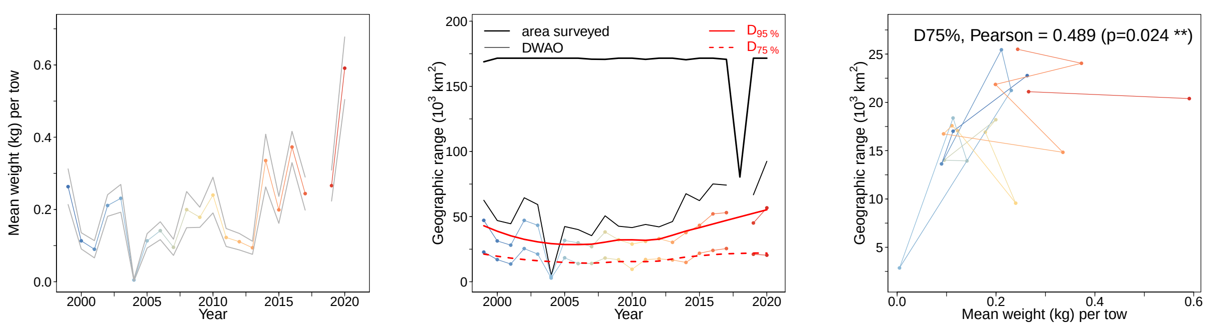



Figure 6.52B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Jonah crab.

## 6.53 Atlantic rock crab (Crabe commun) - species code 2513 (category SF)

Scientific name: Cancer irroratus

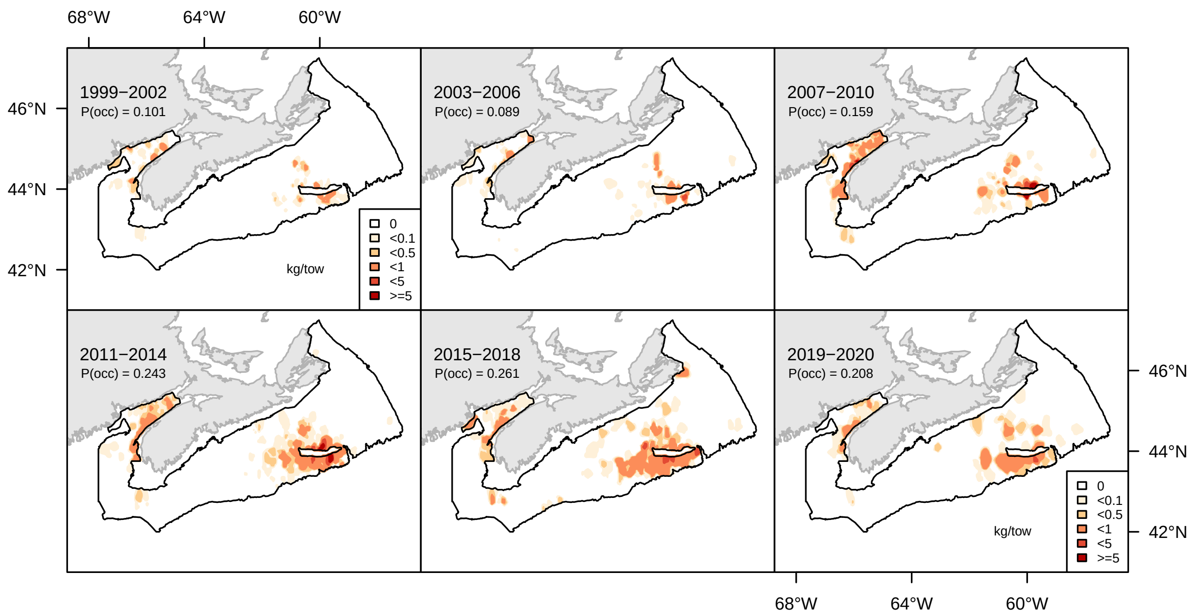



Figure 6.53A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic rock crab.

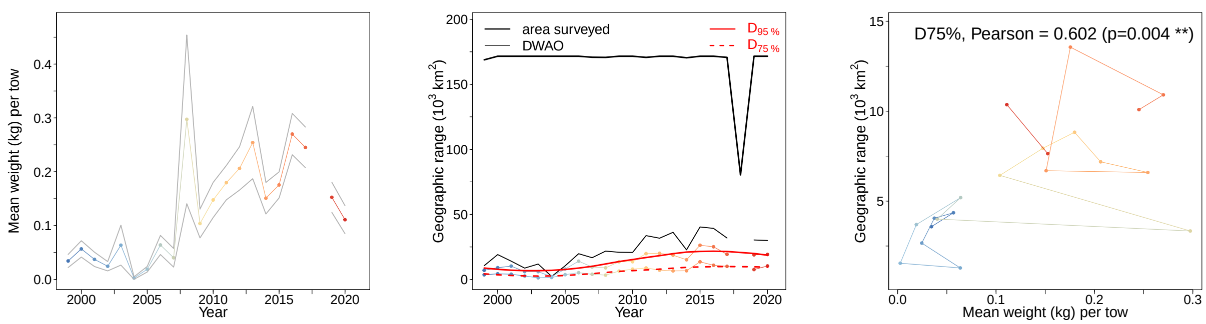



Figure 6.53B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic rock crab.

## 6.54 Arctic lyre crab (Crabe Hyas coarctatus) - species code 2521 (category SF)

Scientific name: [Hyas coarctatus]

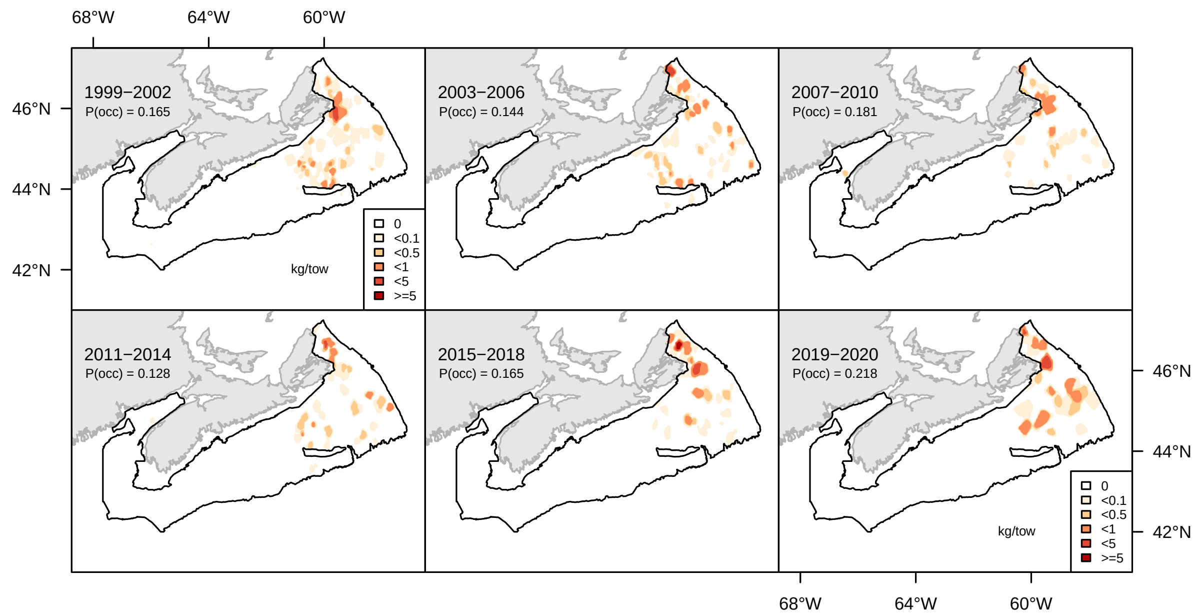



Figure 6.54A. Inverse distance weighted distribution of catch biomass (kg/tow) for Arctic lyre crab.

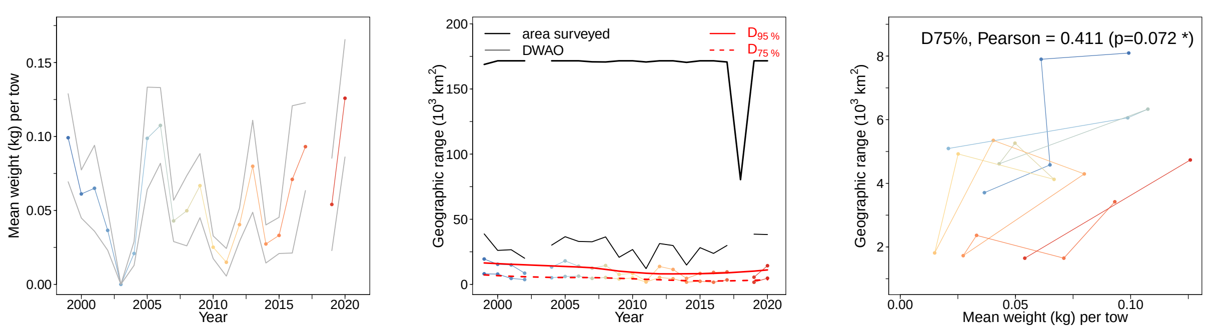



Figure 6.54B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Arctic lyre crab.

### 6.55 Atlantic king crab (Crabe épineux du nord) - species code 2523 (category SF)

Scientific name: [Lithodes maja]

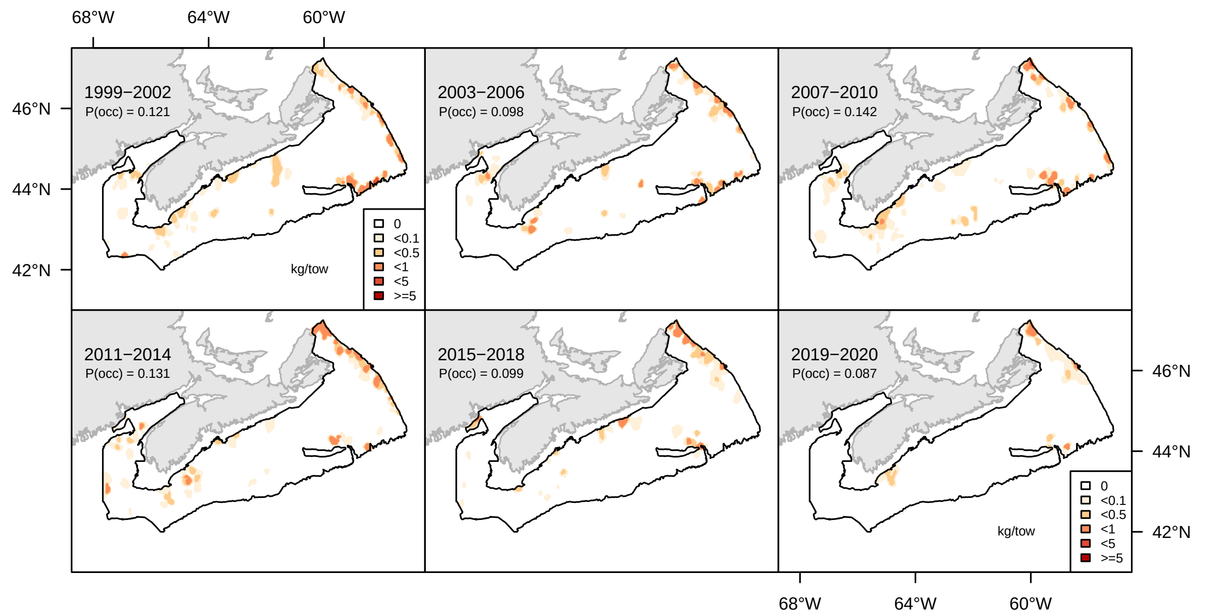



Figure 6.55A. Inverse distance weighted distribution of catch biomass (kg/tow) for Atlantic king crab.

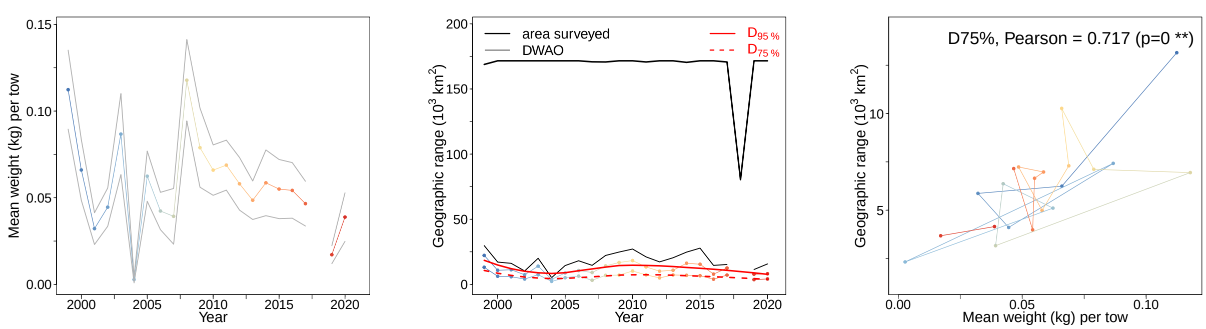



Figure 6.55B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Atlantic king crab.

## 6.56 Queen crab (Crabe des neiges) - species code 2526 (category SF)

Scientific name: Chionoecetes opilio

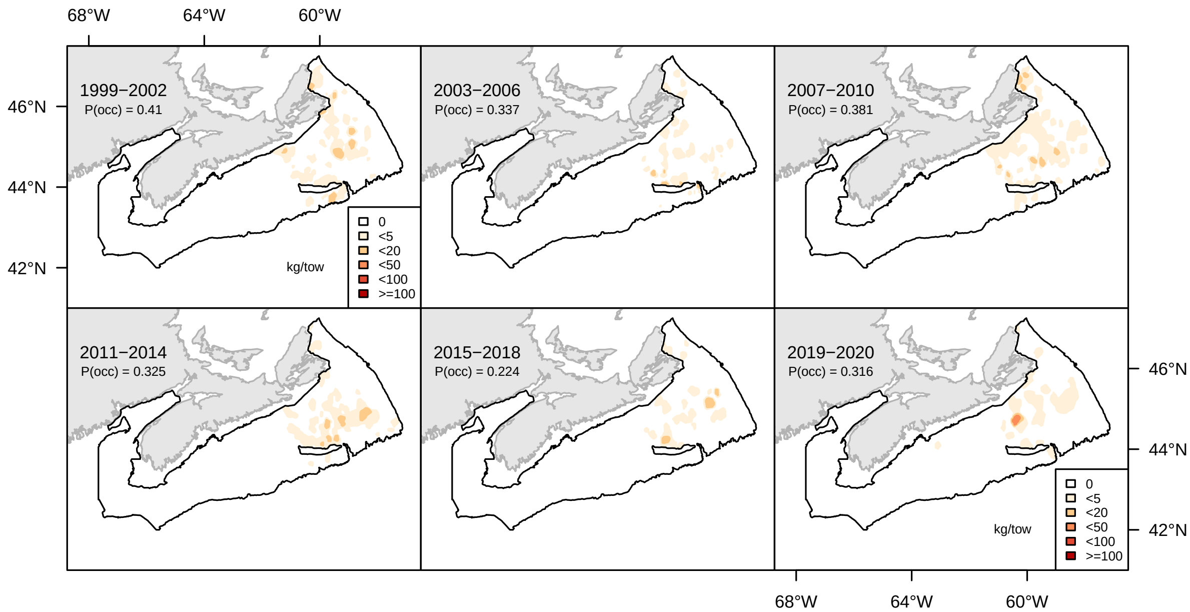



Figure 6.56A. Inverse distance weighted distribution of catch biomass (kg/tow) for Queen crab.

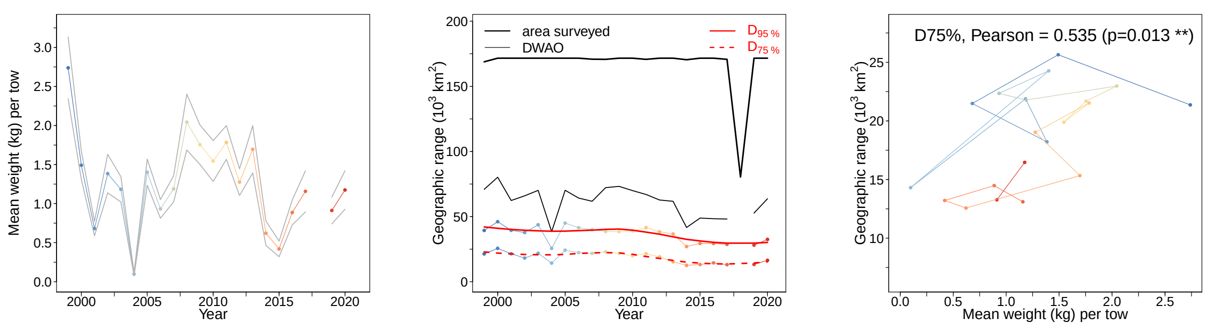



Figure 6.56B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Queen crab.

## 6.57 Great spider crab (Crabe lyre araignée) - species code 2527 (category SF)

Scientific name: Hyas araneus

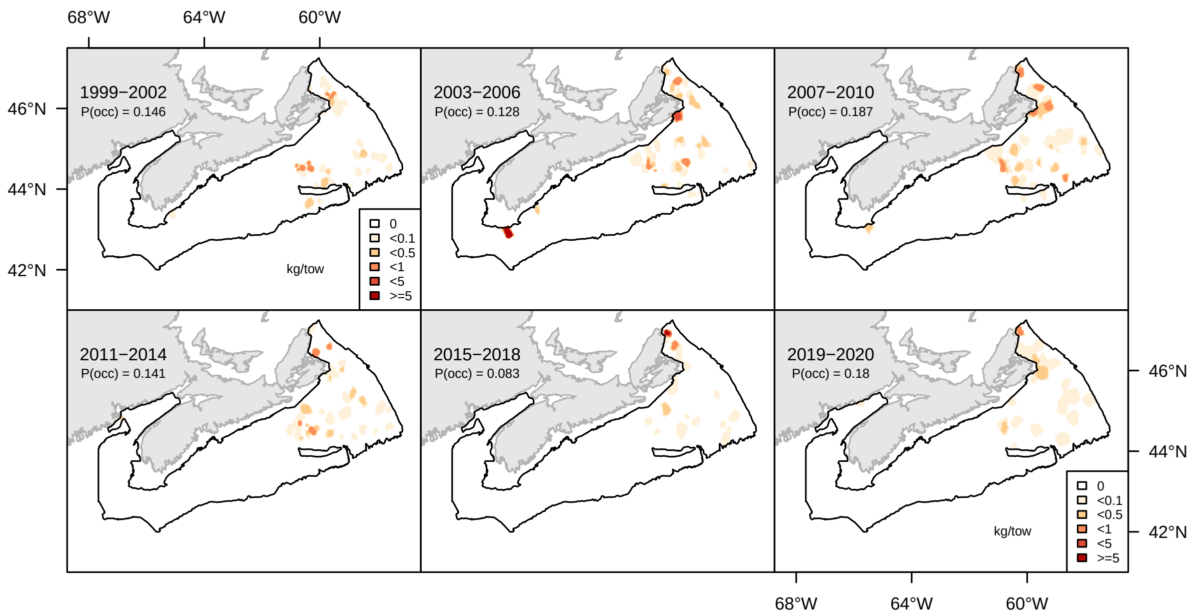



Figure 6.57A. Inverse distance weighted distribution of catch biomass (kg/tow) for Great spider crab.

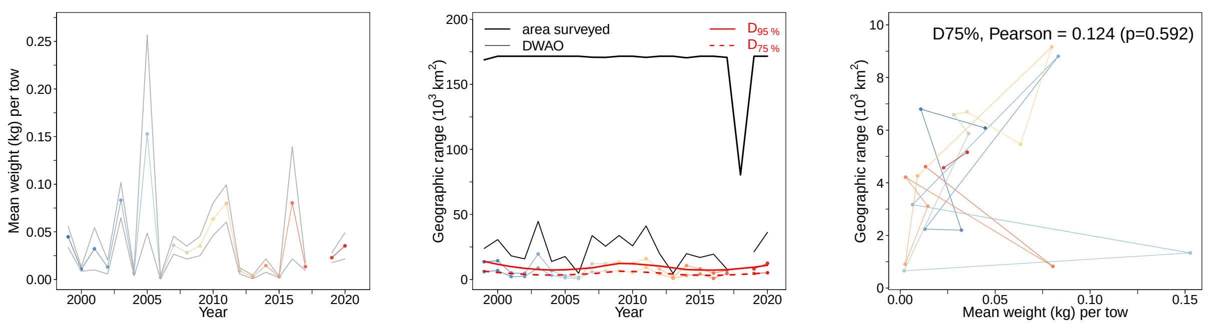



Figure 6.57B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of Great spider crab.

## 6.58 American lobster (Homard américain) - species code 2550 (category SF)

Scientific name: Homarus americanus

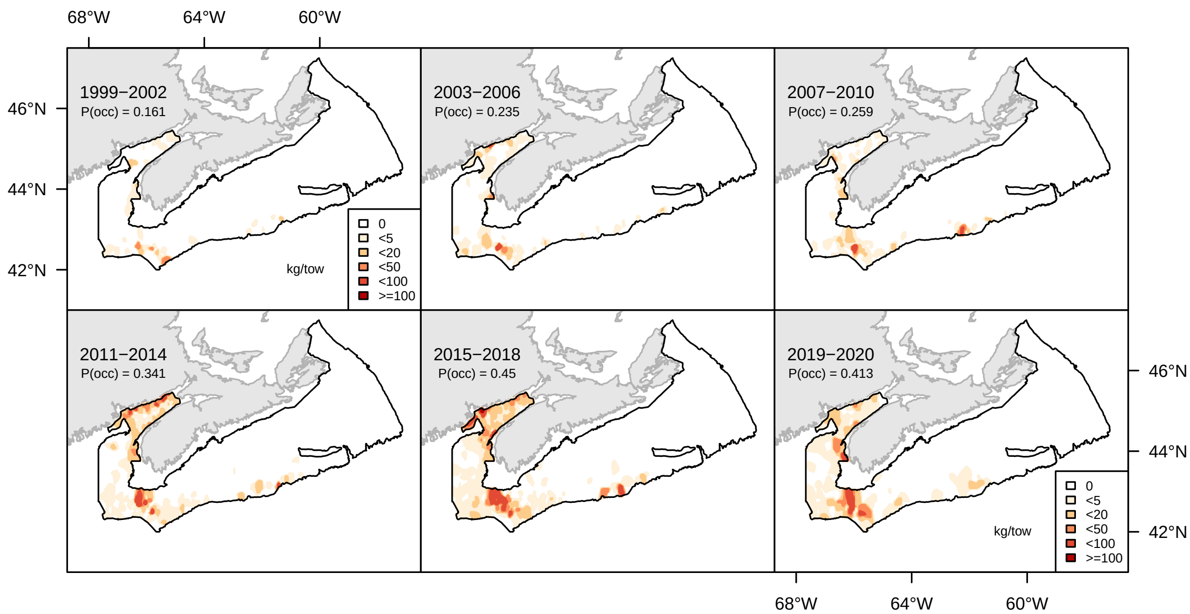



Figure 6.58A. Inverse distance weighted distribution of catch biomass (kg/tow) for American lobster.

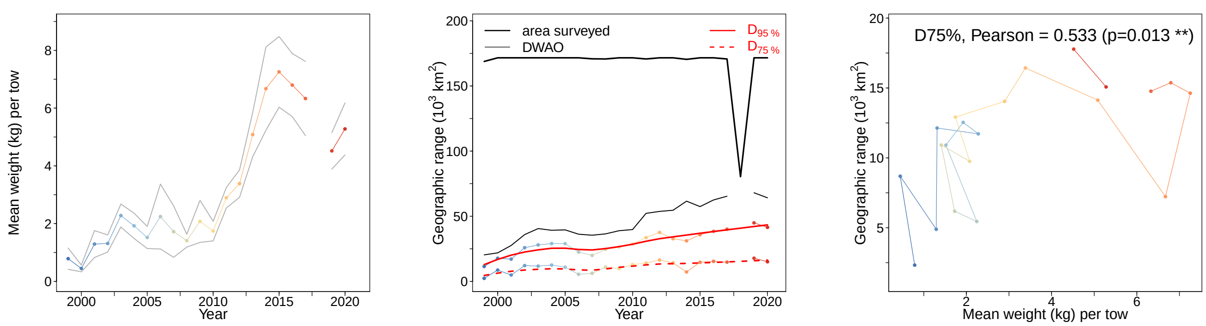



Figure 6.58B. Stratified random estimates of biomass (kg/tow), D75 and D95 and the correlation between D75 and biomass of American lobster.

### 6.59 Sea lamprey (Lamproie marine) - species code 240 (category LR)

Scientific name: Petromyzon marinus

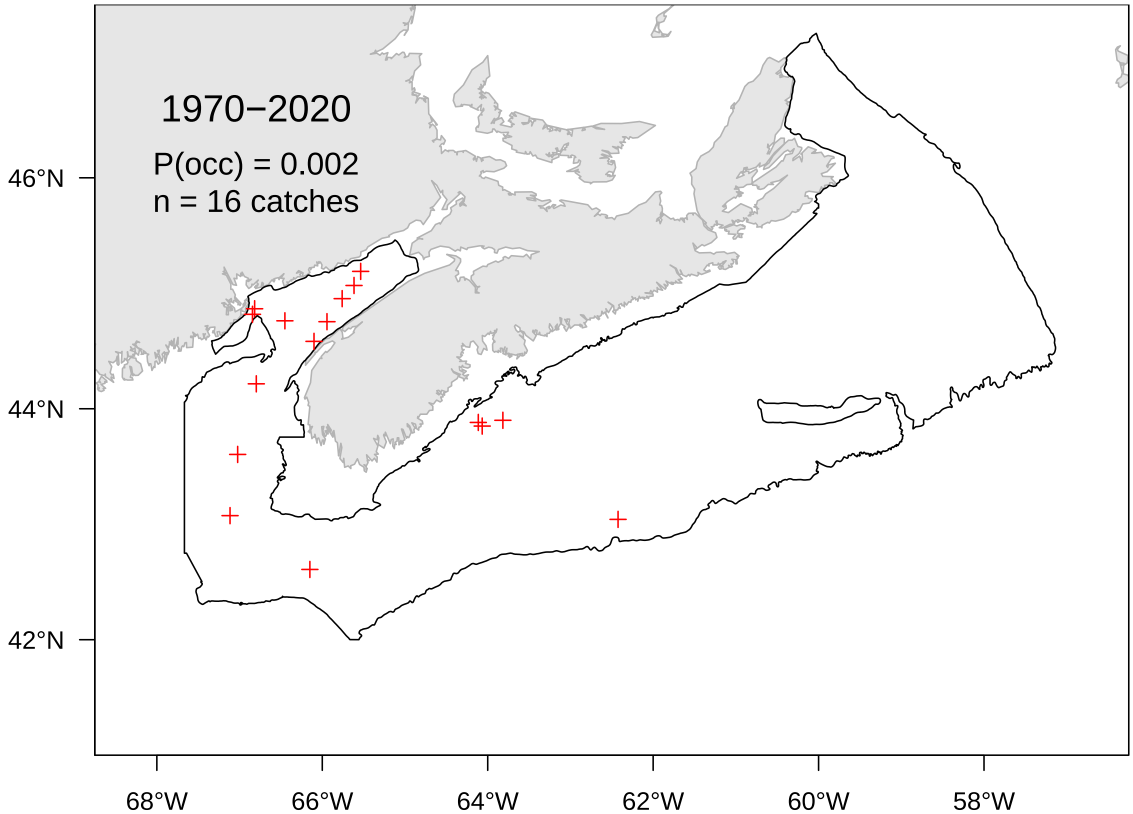



Figure 6.59A. Catch distribution for Sea lamprey.

### 6.60 Atlantic tomcod (Poulamon atlantique) - species code 17 (category LR)

Scientific name: [Microgadus tomcod]

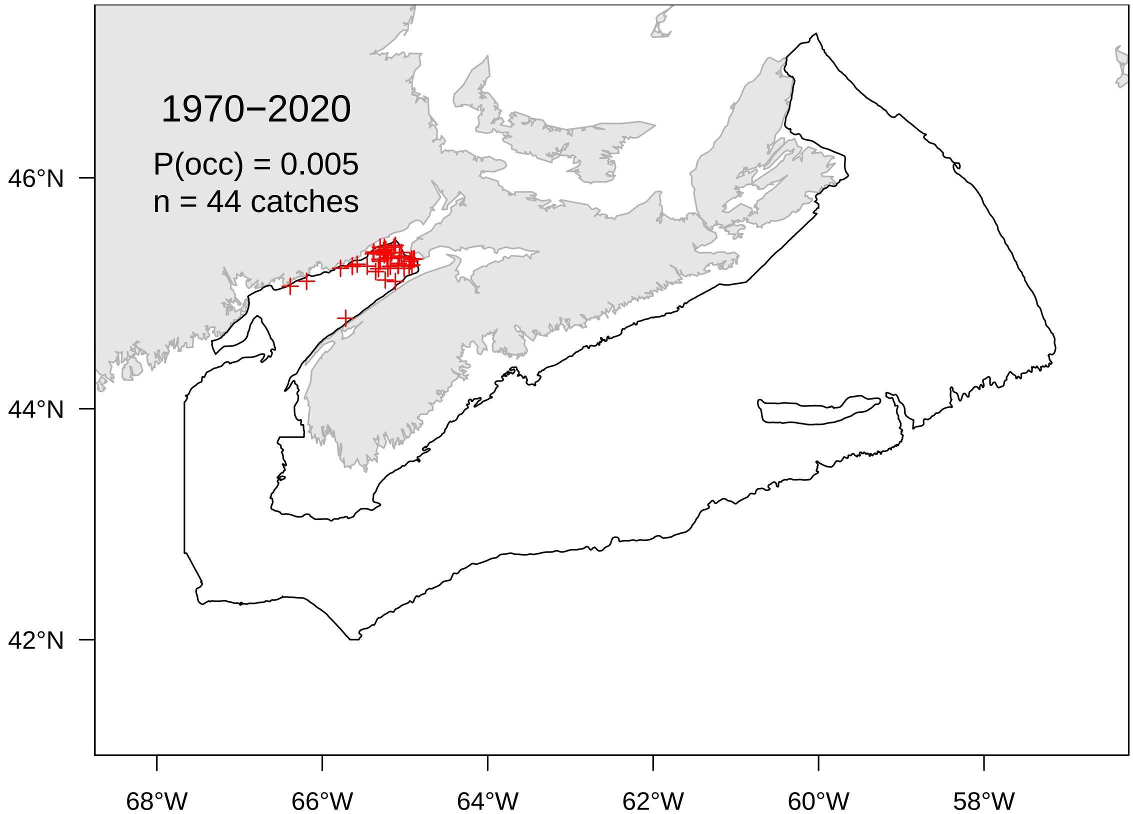



Figure 6.60A. Catch distribution for Atlantic tomcod.

### 6.61 Offshore silver hake (Merlu argenté du large) - species code 19 (category LR)

Scientific name: Merluccius albidus

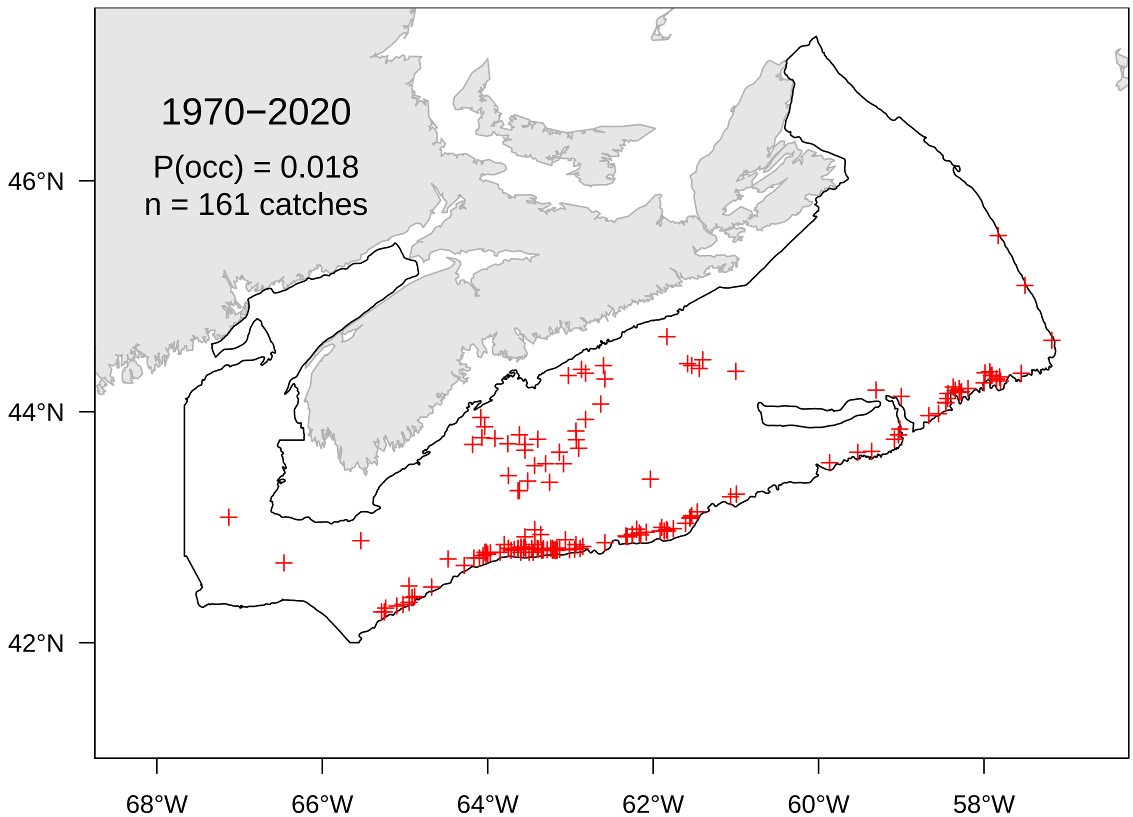



Figure 6.61A. Catch distribution for Offshore silver hake.

### 6.62 Roughnose grenadier (Grenadier-scie) - species code 412 (category LR)

Scientific name: Trachyrincus murrayi

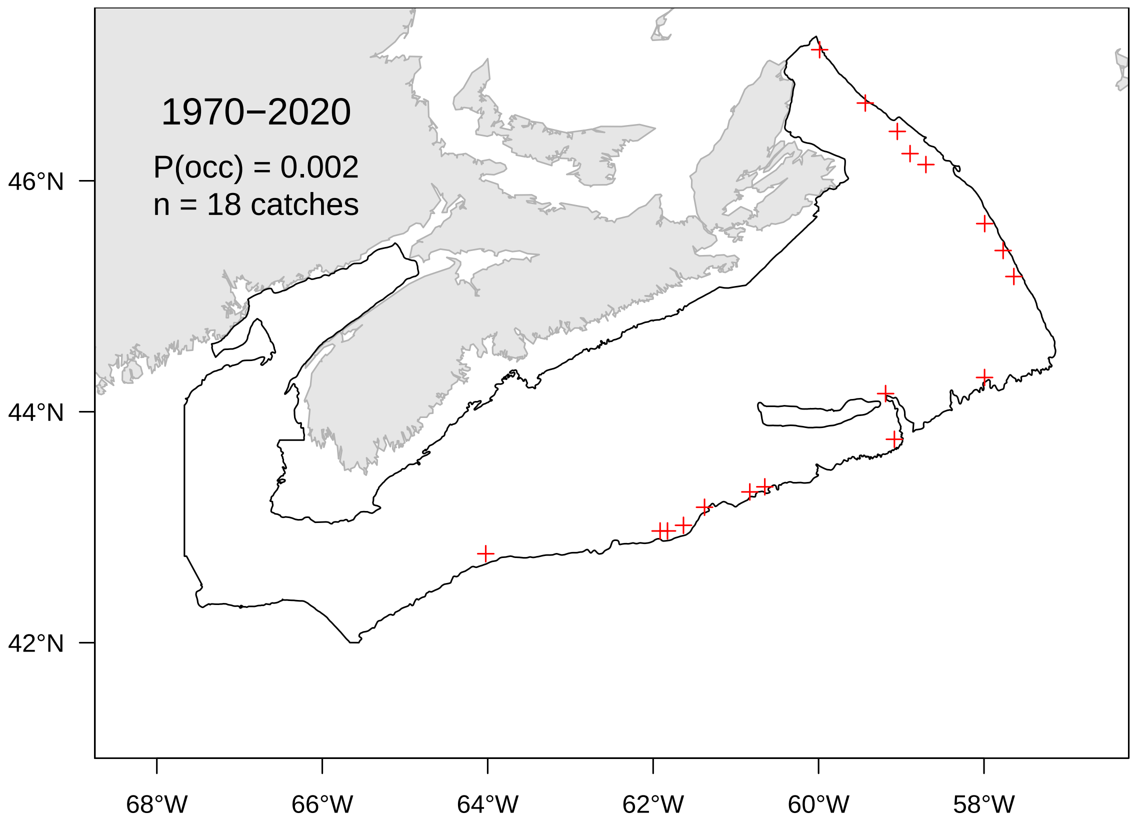



Figure 6.62A. Catch distribution for Roughnose grenadier.

### 6.63 Roundnose grenadier (Grenadier de roche) - species code 414 (category LR)

Scientific name: Coryphaenoides rupestris

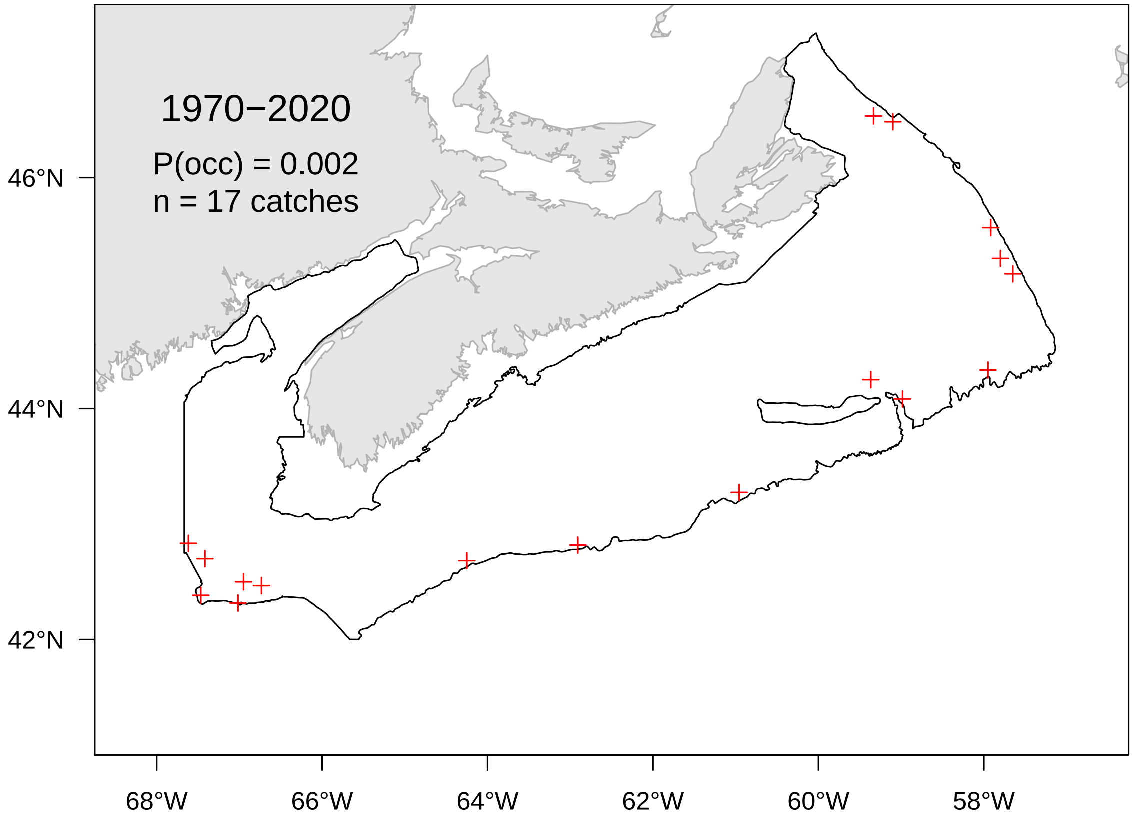



Figure 6.63A. Catch distribution for Roundnose grenadier.

### 6.64 Fourspot flounder (Cardeau à quatre ocelles) - species code 142 (category LR)

Scientific name: Hippoglossina oblonga

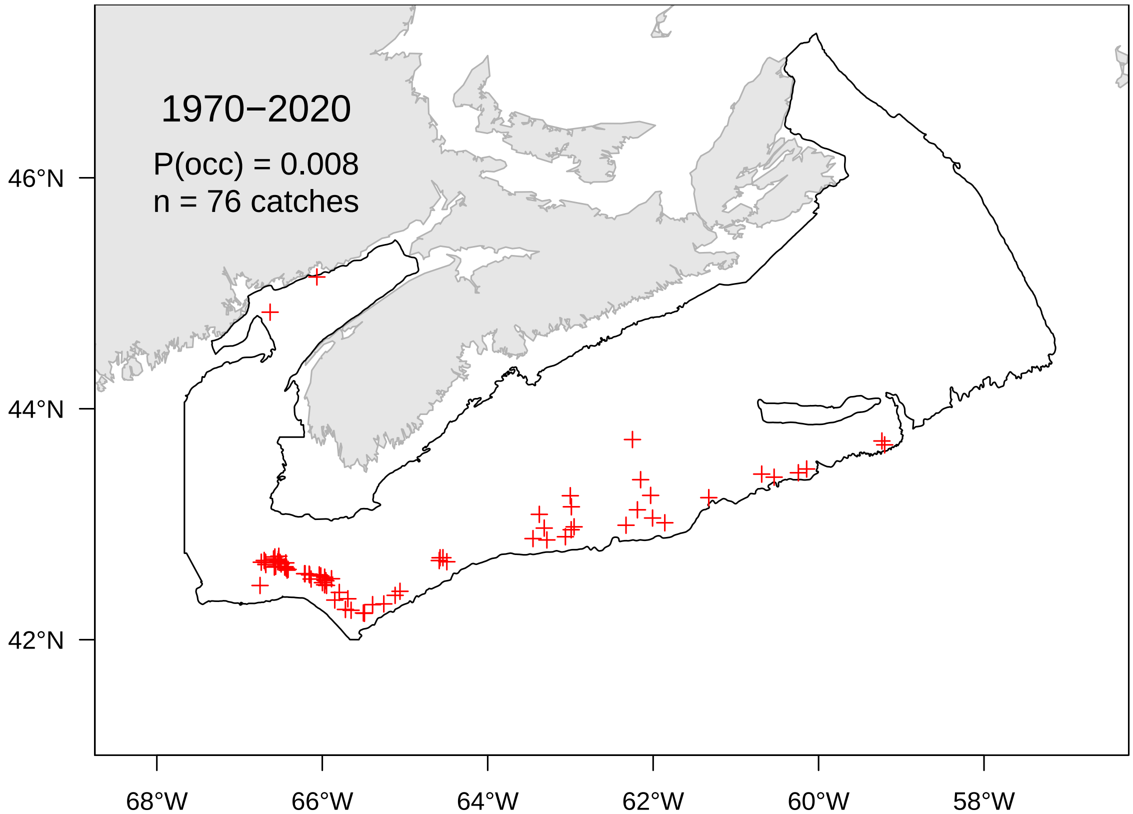



Figure 6.64A. Catch distribution for Fourspot flounder.

### 6.65 Windowpane flounder (Turbot de sable) - species code 143 (category LR)

Scientific name: Scophthalmus aquosus

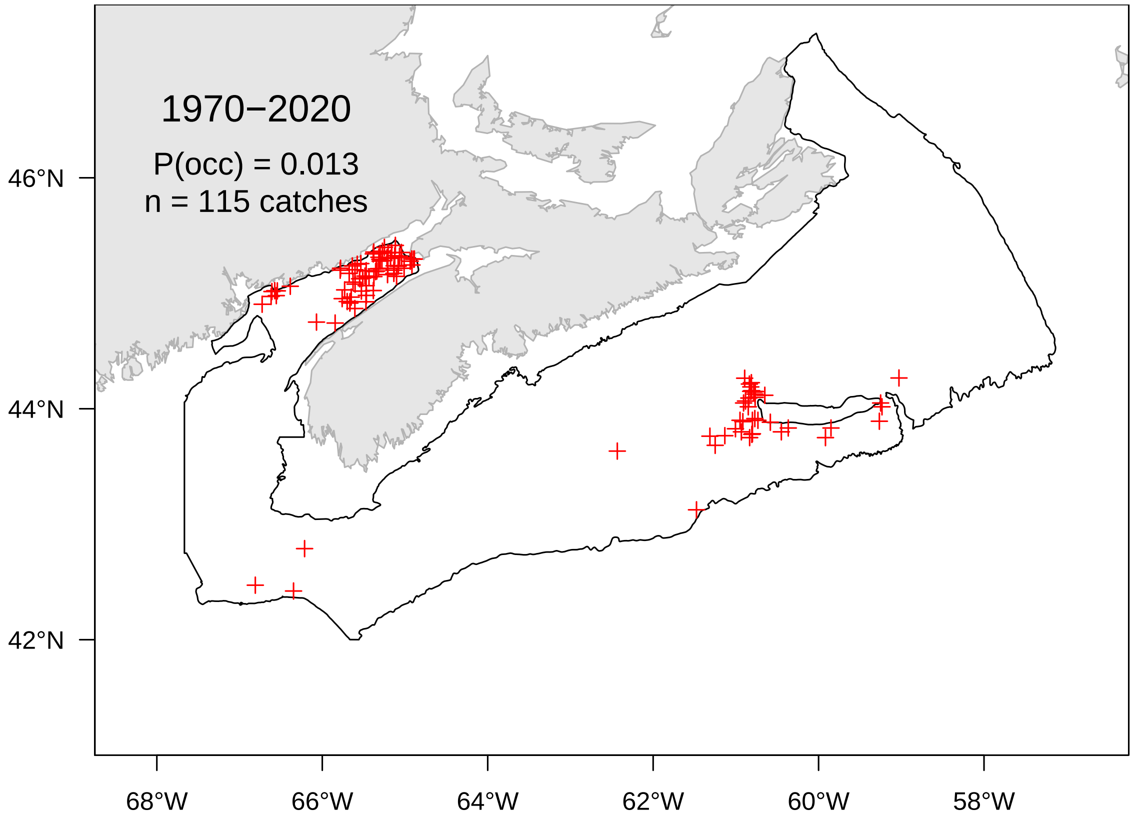



Figure 6.65A. Catch distribution for Windowpane flounder.

### 6.66 Spottedfin tonguefish (Langue fil noir) - species code 816 (category LR)

Scientific name: Symphurus diomedeanus

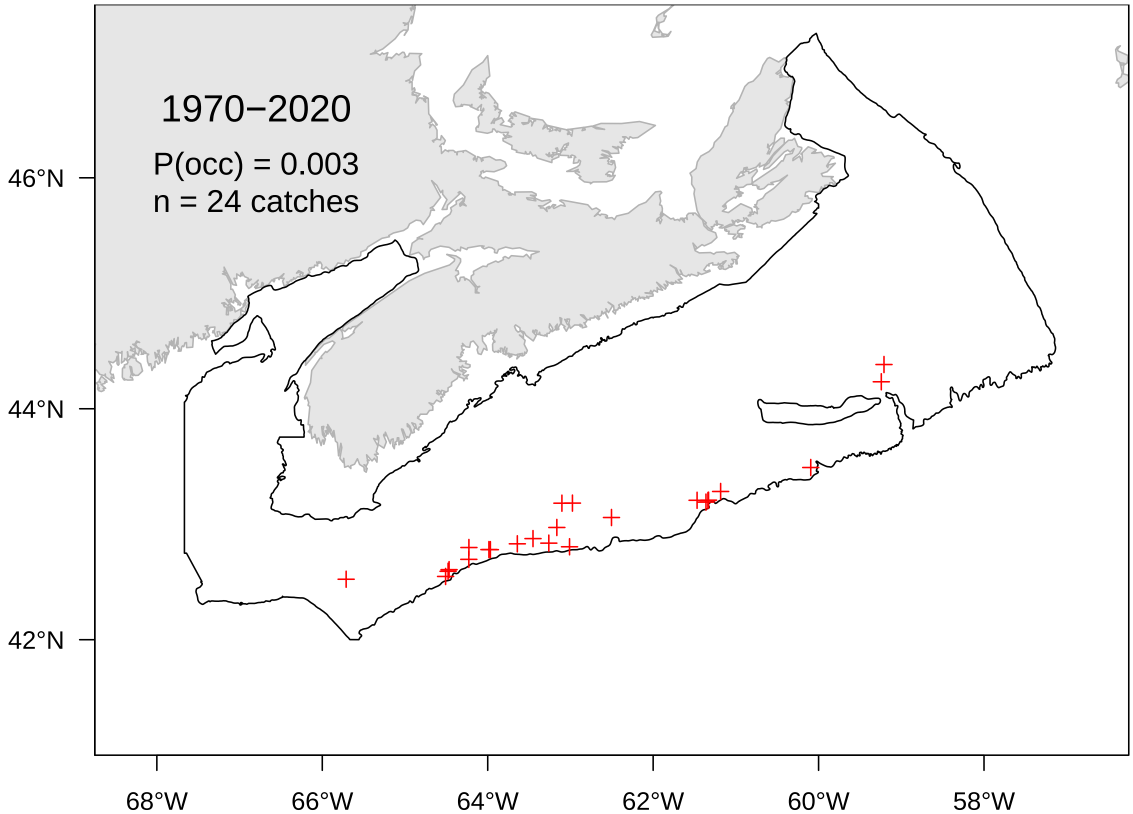



Figure 6.66A. Catch distribution for Spottedfin tonguefish.

### 6.67 Spotted wolffish (Loup tacheté) - species code 51 (category LR)

Scientific name: Anarhichas minor

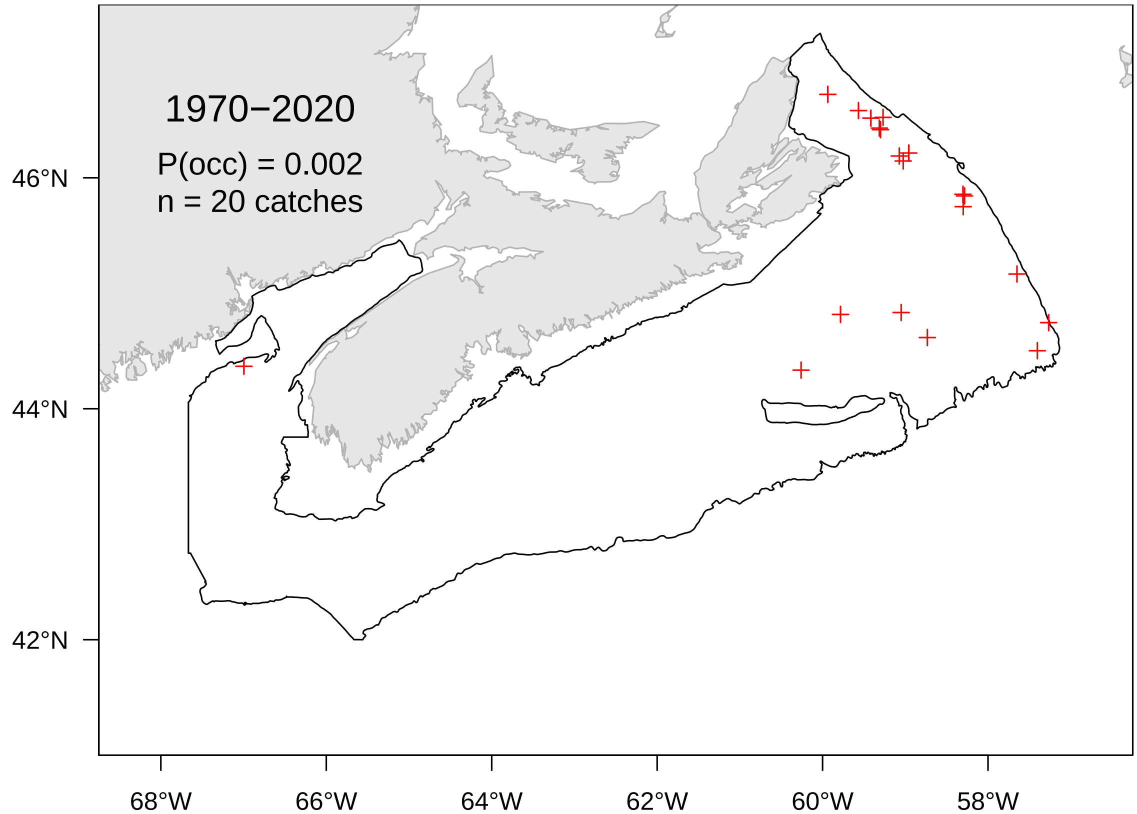



Figure 6.67A. Catch distribution for Spotted wolffish.

## 6.68 Northern wolffish (Loup à tête large) - species code 52 (category LR)

Scientific name: Anarhichas denticulatus

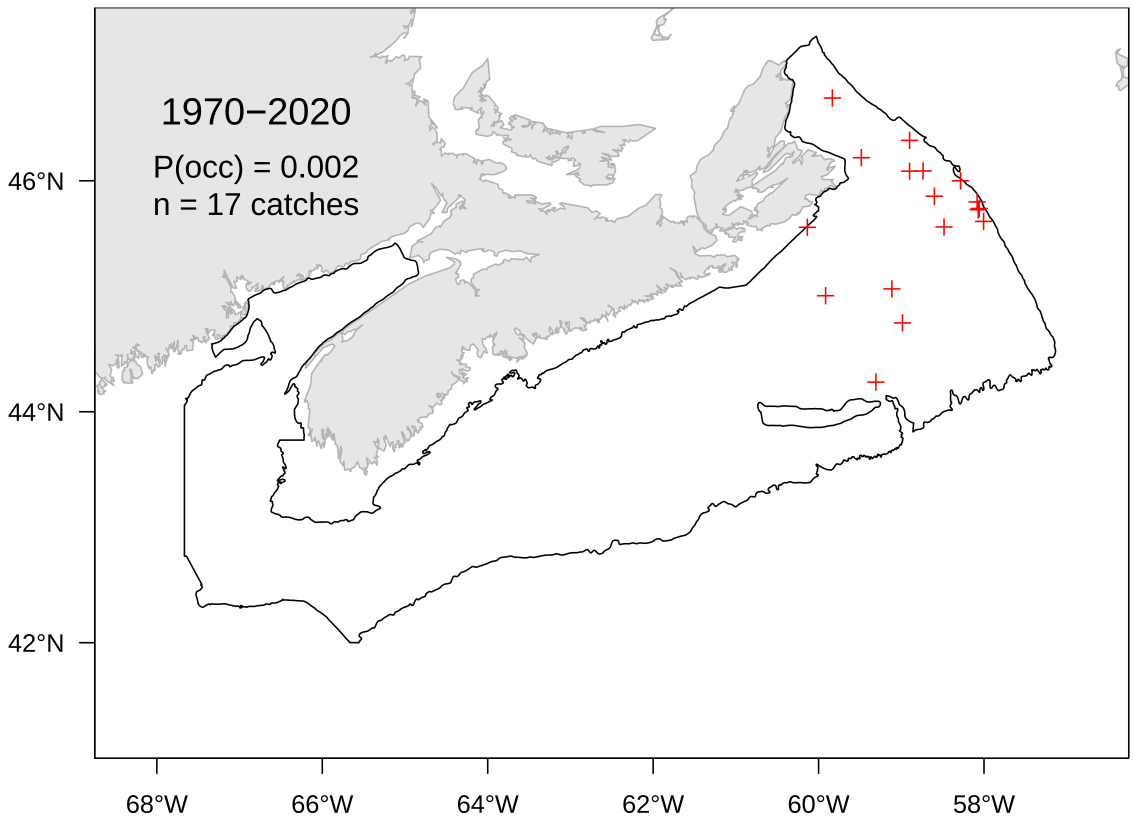



Figure 6.68A. Catch distribution for Northern wolffish.

### 6.69 Shorthorn sculpin (Chaboisseau à épines courtes) - species code 301 (category LR)

Scientific name: Myoxocephalus scorpius

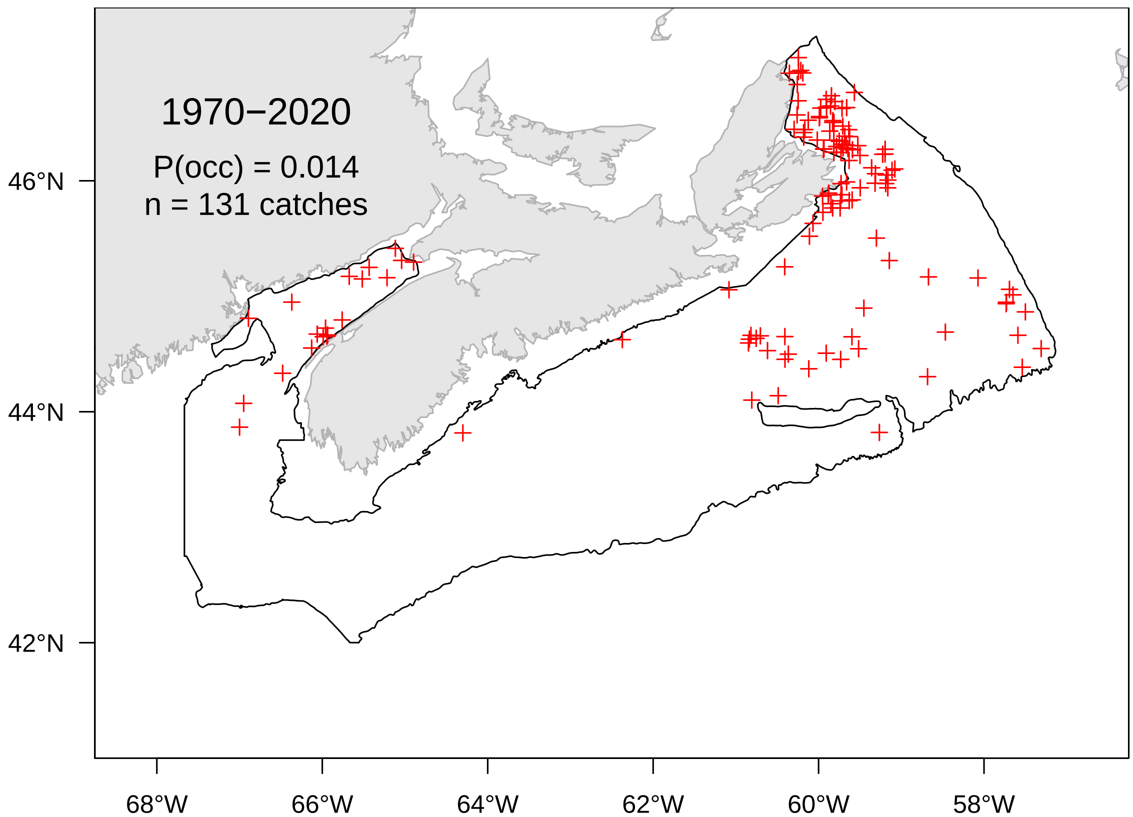



Figure 6.69A. Catch distribution for Shorthorn sculpin.

### 6.70 Grubby (Chaboisseau bronzé) - species code 303 (category LR)

Scientific name: Myoxocephalus aenaeus

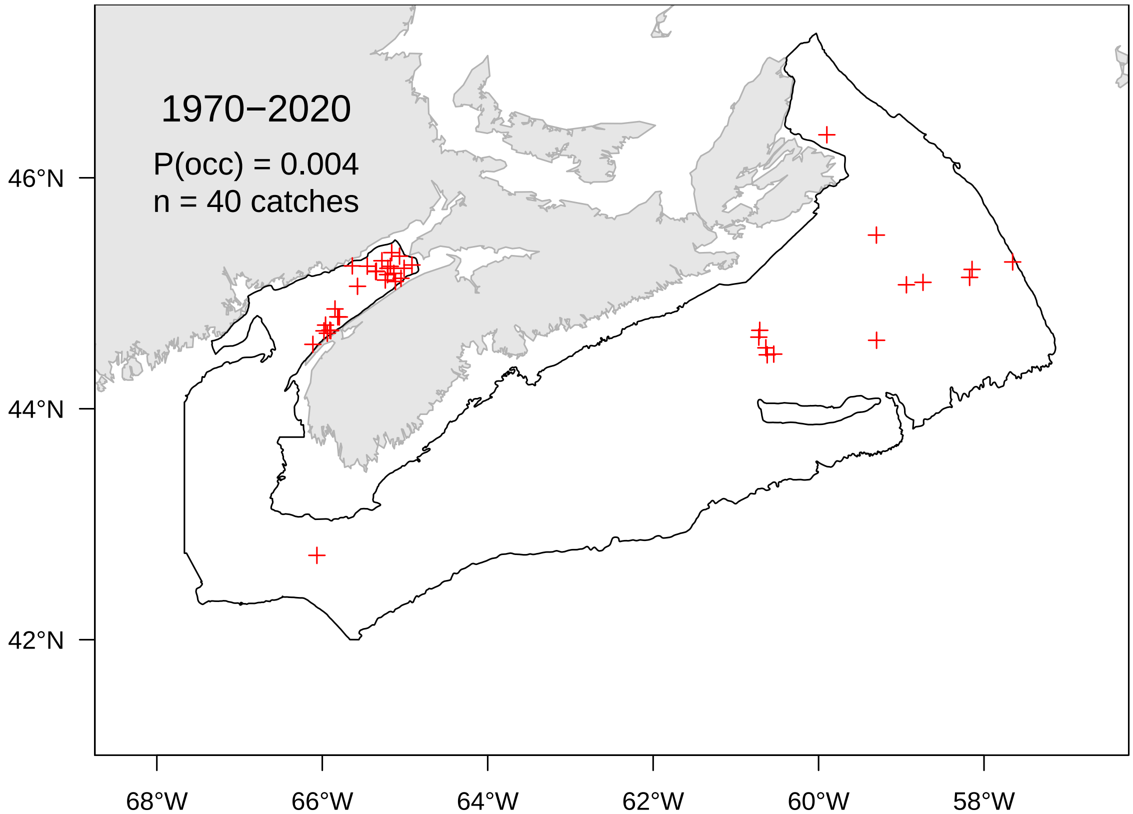



Figure 6.70A. Catch distribution for Grubby.

### 6.71 Polar sculpin (Cotte polaire) - species code 307 (category LR)

Scientific name: Cottunculus microps

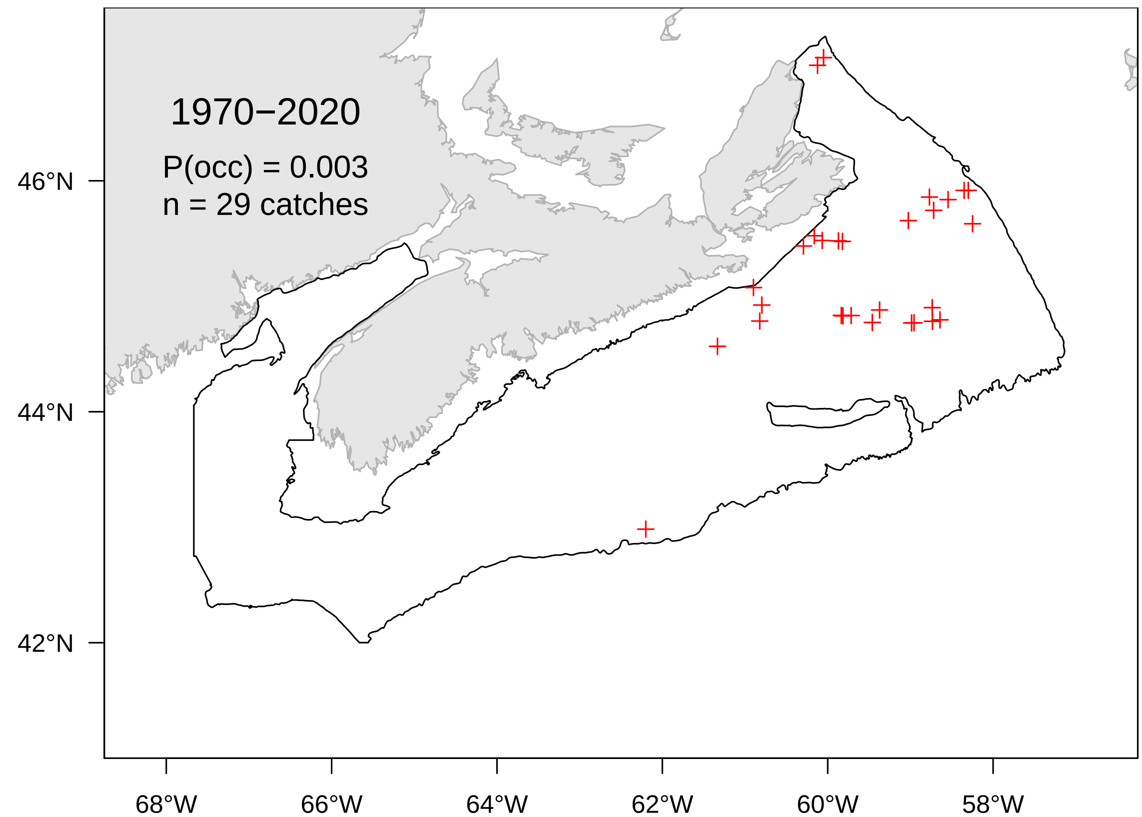



Figure 6.71A. Catch distribution for Polar sculpin.

### 6.72 Spatulate sculpin (Icèle spatulée) - species code 314 (category LR)

Scientific name: Icelus spatula

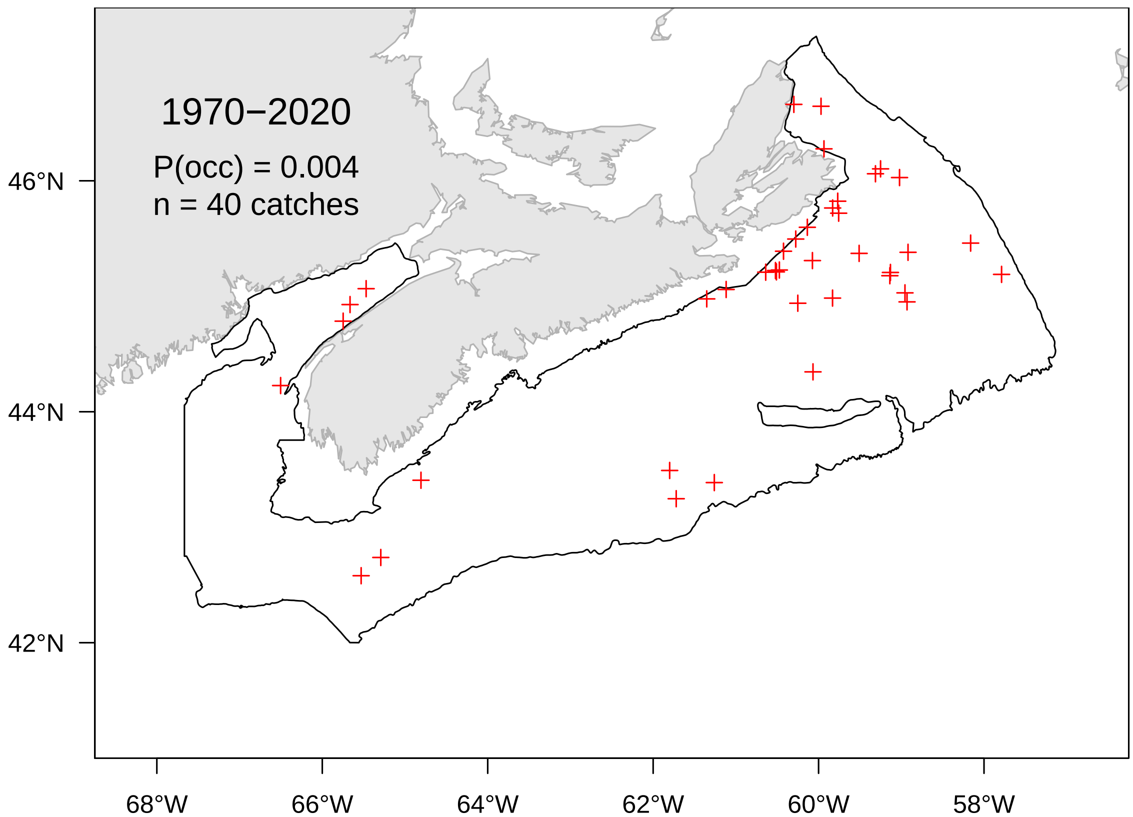



Figure 6.72A. Catch distribution for Spatulate sculpin.

### 6.73 Arctic alligatorfish (Poisson-alligator arctique) - species code 341 (category LR)

Scientific name: [Ulcina olrikii]

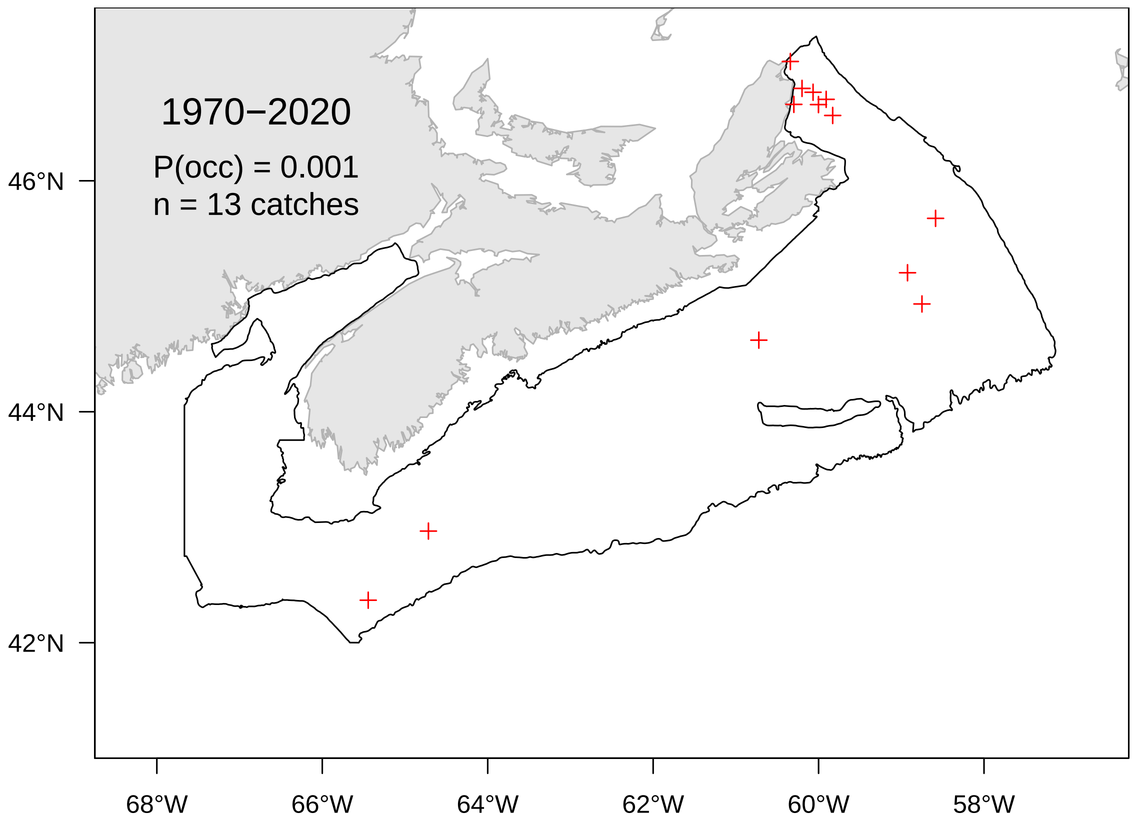



Figure 6.73A. Catch distribution for Arctic alligatorfish.

### 6.74 Atlantic seasnail (Limace atlantique) - species code 503 (category LR)

Scientific name: [Liparis atlanticus]

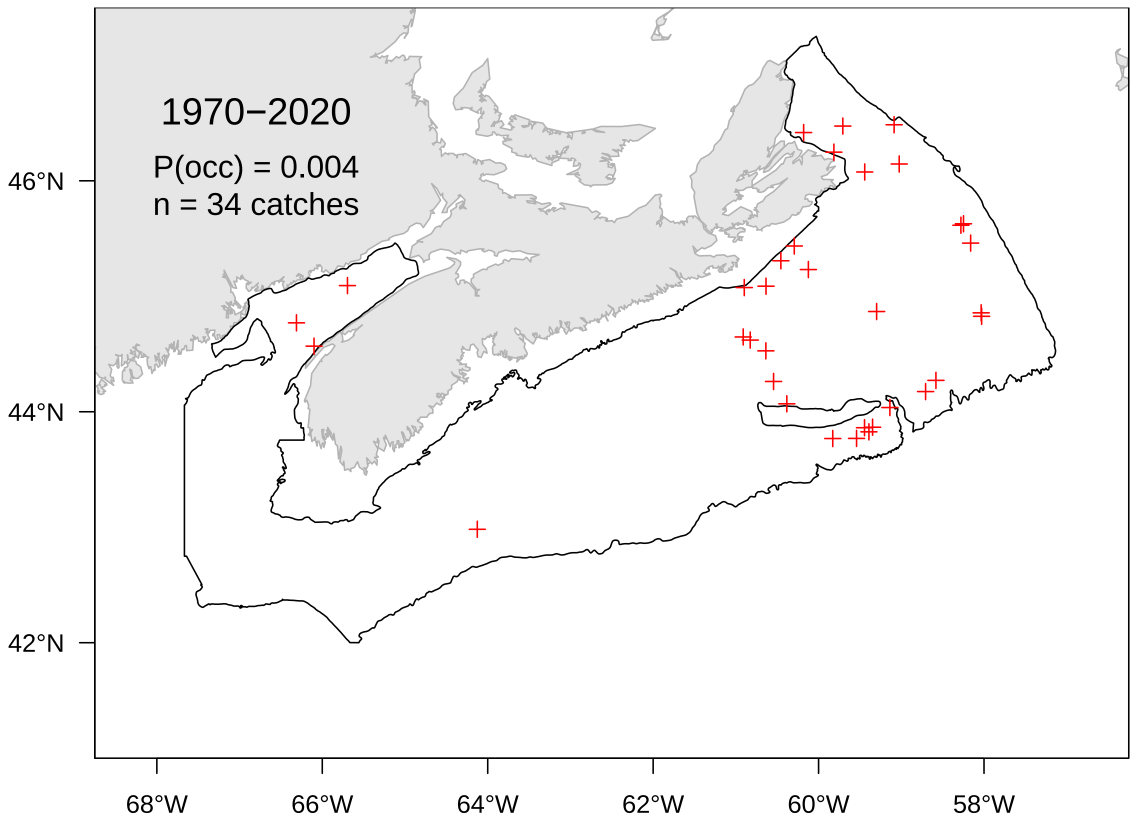



Figure 6.74A. Catch distribution for Atlantic seasnail.

### 6.75 Gelatinous snailfish (Limace gélatineuse) - species code 505 (category LR)

Scientific name: Liparis fabricii

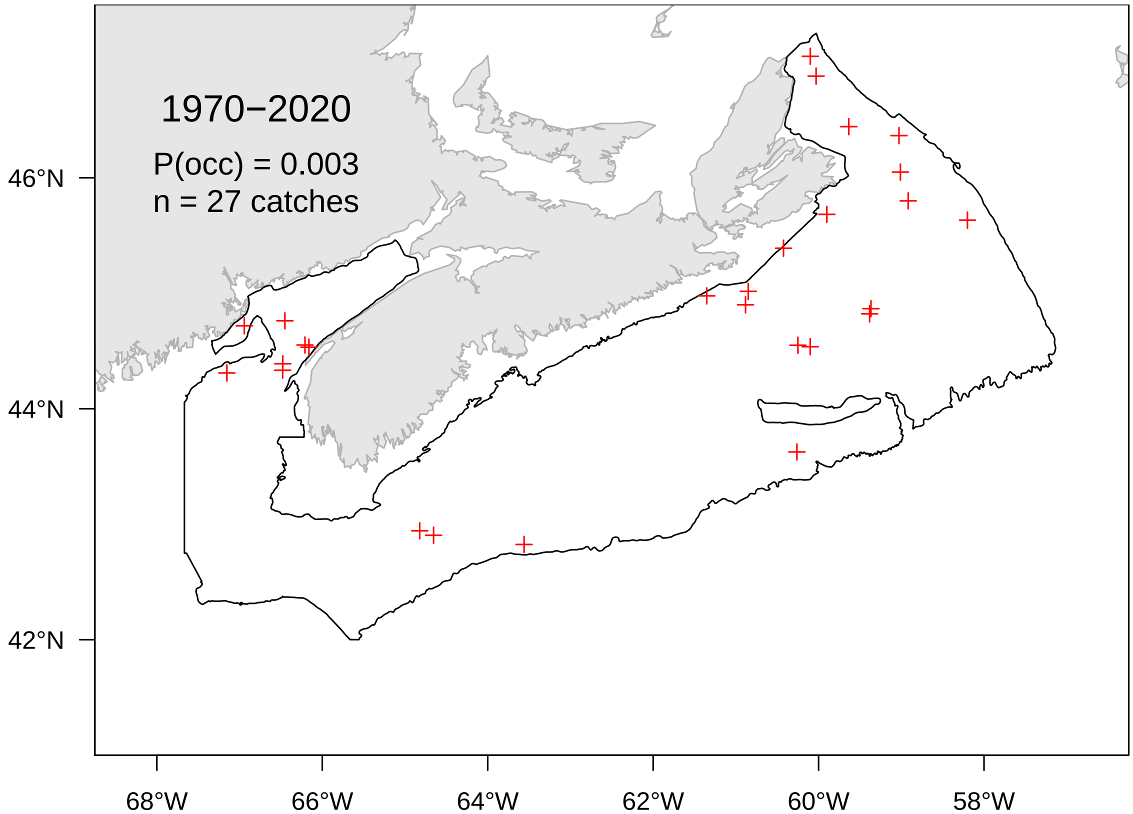



Figure 6.75A. Catch distribution for Gelatinous snailfish.

### 6.76 Variegated snailfish (Limace marbée) - species code 512 (category LR)

Scientific name: [Liparis gibbus]

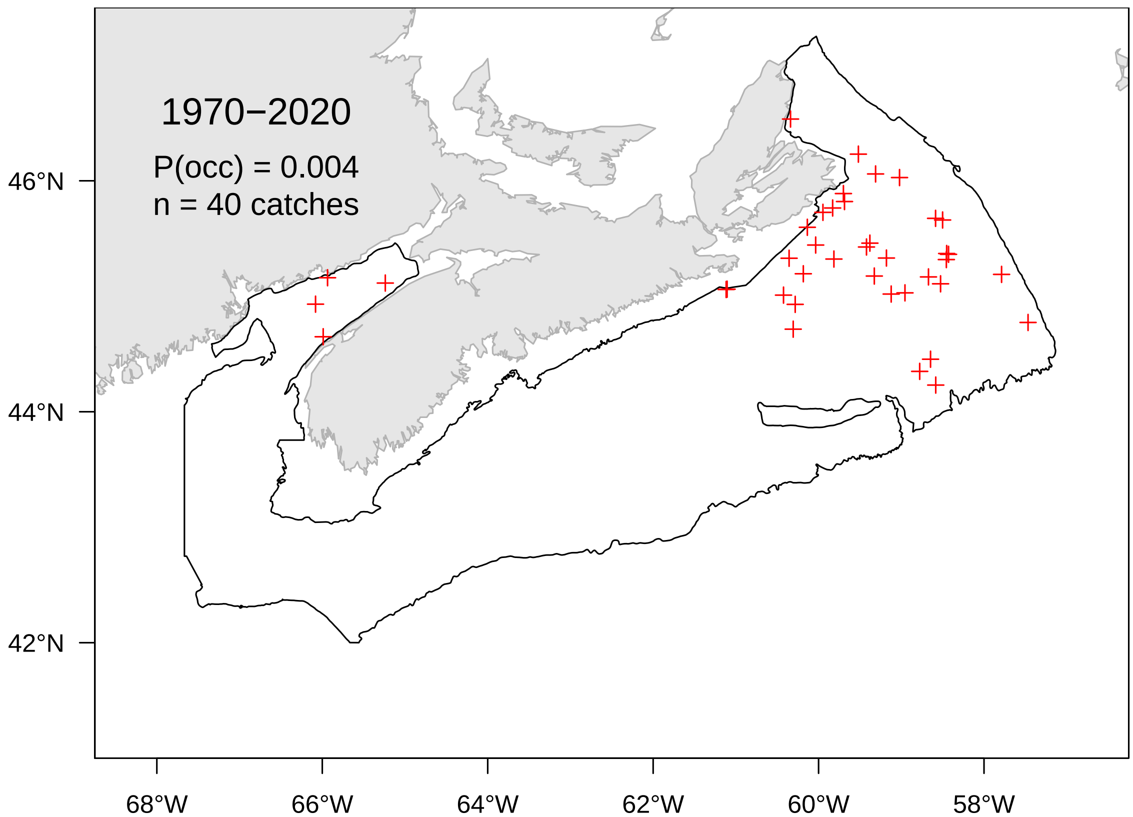



Figure 6.76A. Catch distribution for Variegated snailfish.

### 6.77 Sea tadpole (Petite limace de mer) - species code 520 (category LR)

Scientific name: Careproctus reinhardti

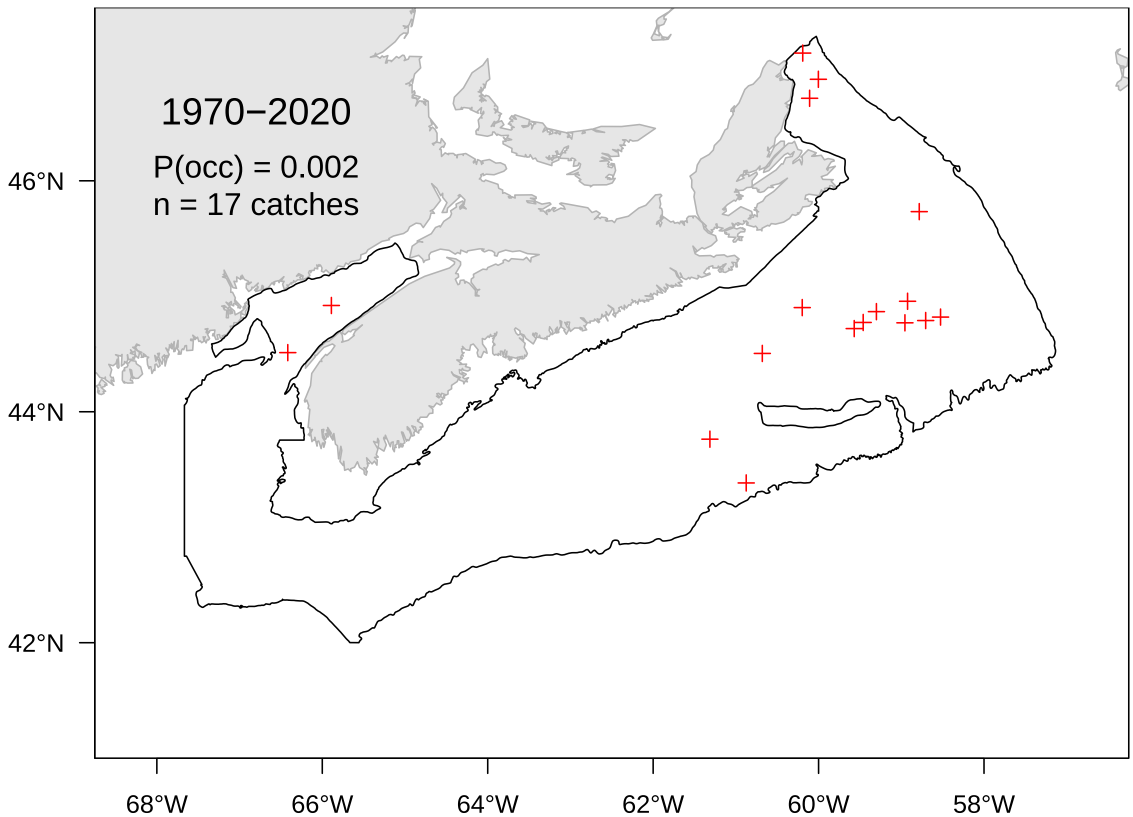



Figure 6.77A. Catch distribution for Sea tadpole.

## 6.78 Wolf eelpout (Lycode à tête longue) - species code 603 (category LR)

Scientific name: Lycenchelys verrillii

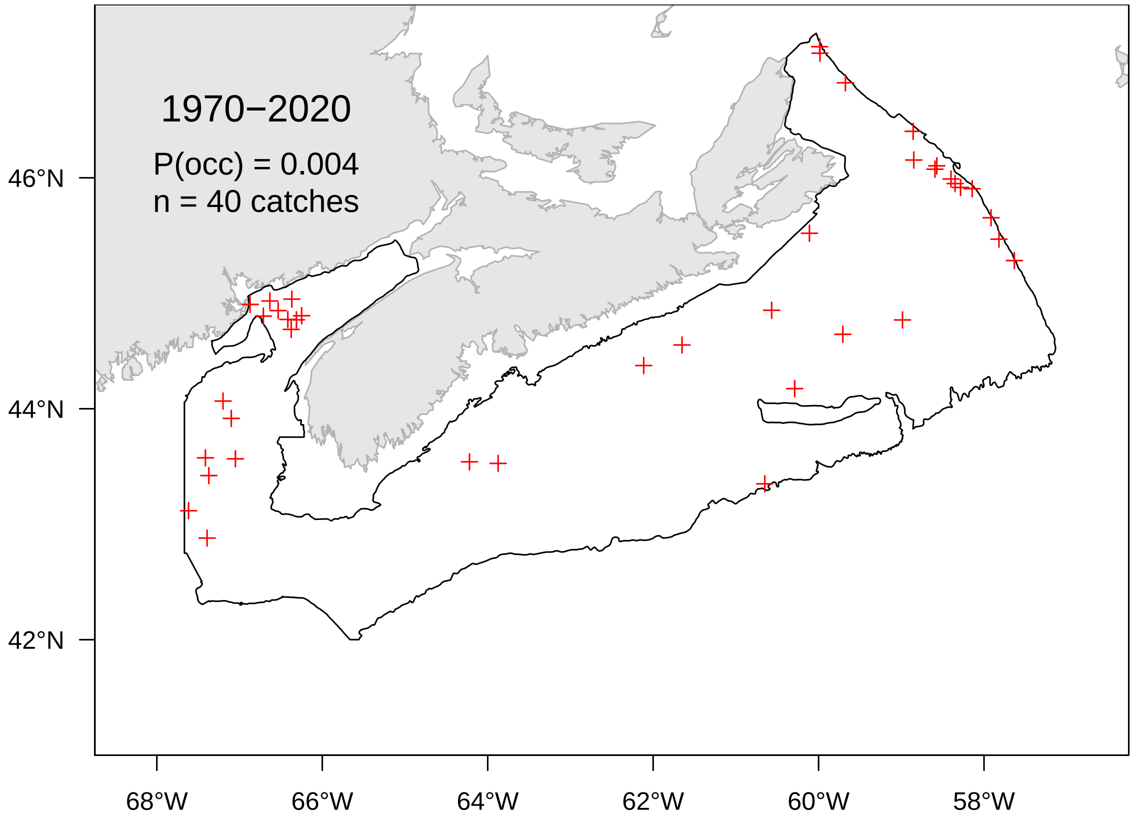



Figure 6.78A. Catch distribution for Wolf eelpout.

### 6.79 Newfoundland eelpout (Lycode du Labrador) - species code 619 (category LR)

Scientific name: [Lycodes terraenovae]

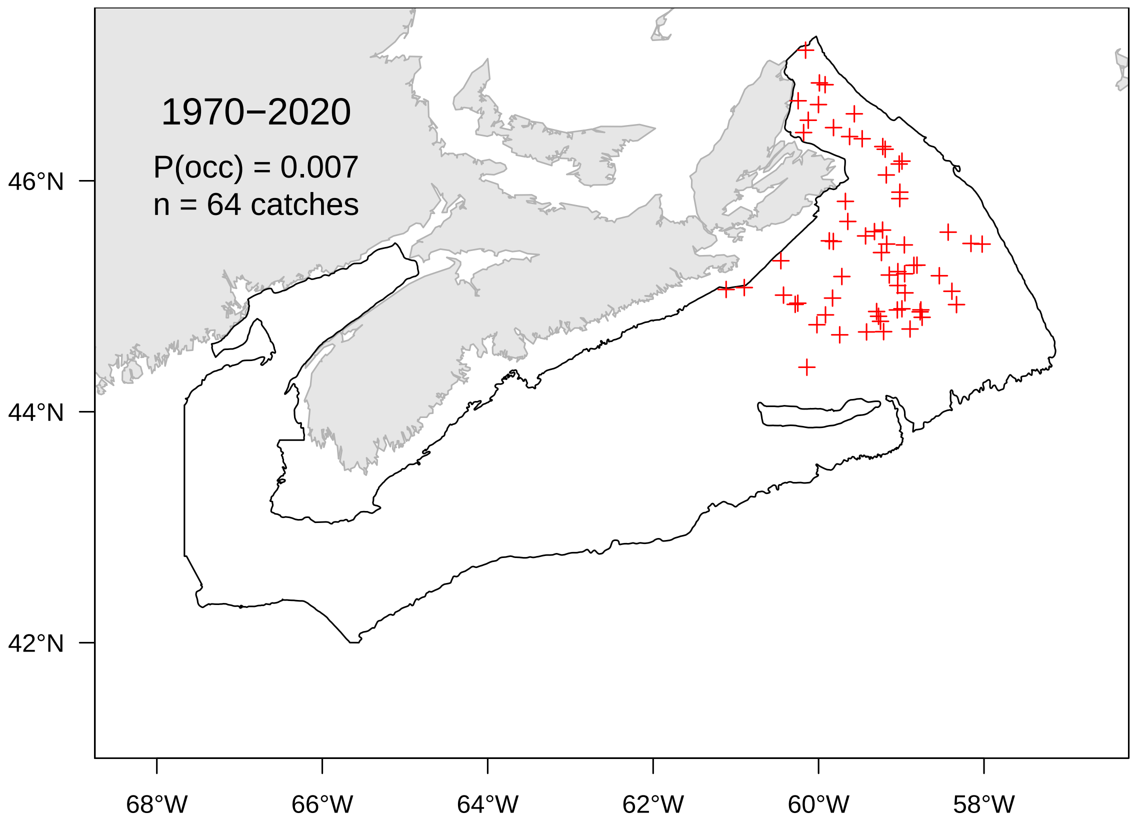



Figure 6.79A. Catch distribution for Newfoundland eelpout.

### 6.80 Newfoundland eelpout (Lycode du Labrador) - species code 620 (category LR)

Scientific name: [Lycodes lavalaei]

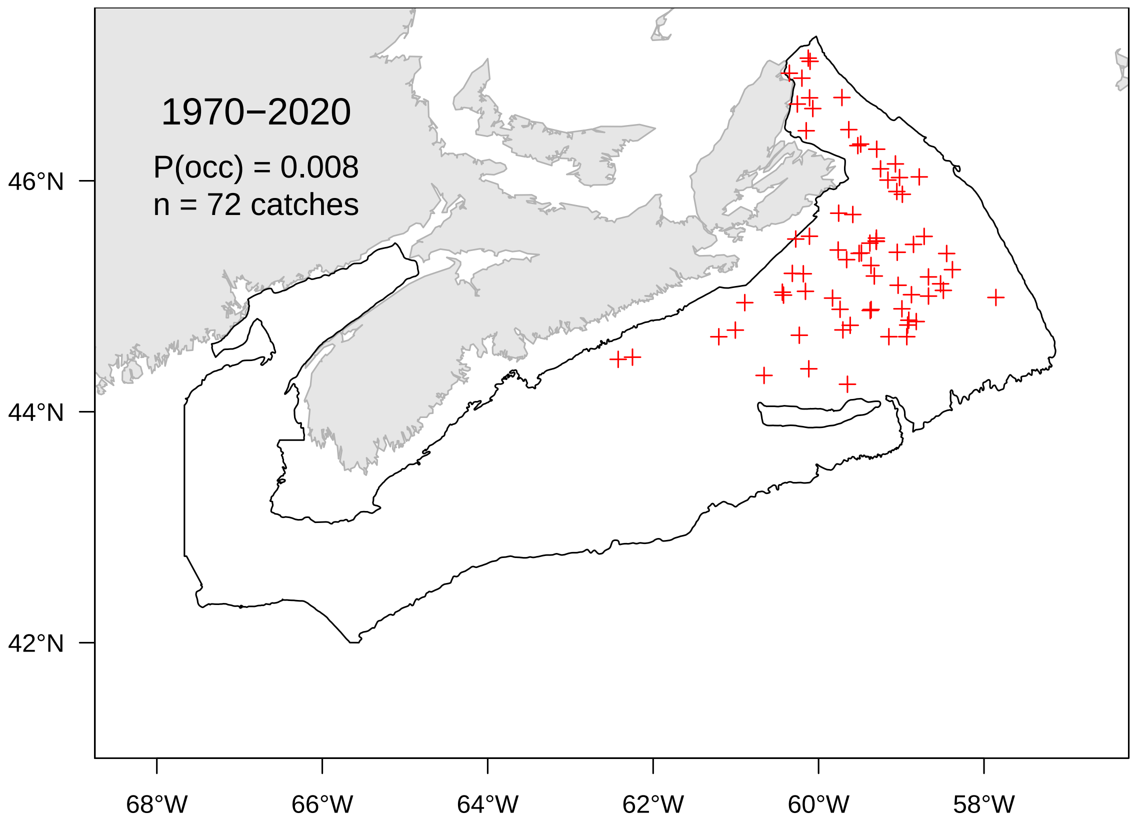



Figure 6.80A. Catch distribution for Newfoundland eelpout.

### 6.81 Rock gunnel (Sigouine de roche) - species code 621 (category LR)

Scientific name: Pholis gunnellus

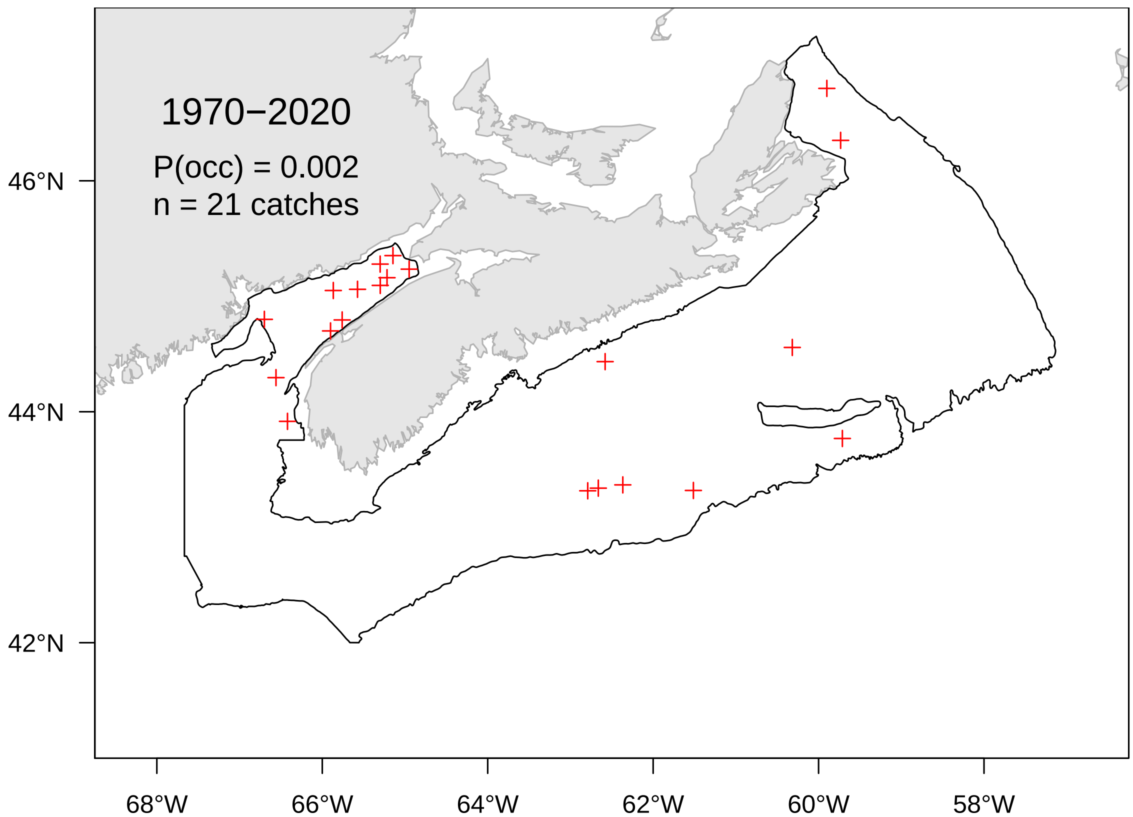



Figure 6.81A. Catch distribution for Rock gunnel.

### 6.82 Radiated shanny (Ulvaire deux-lignes) - species code 625 (category LR)

Scientific name: Ulvaria subbifurcata

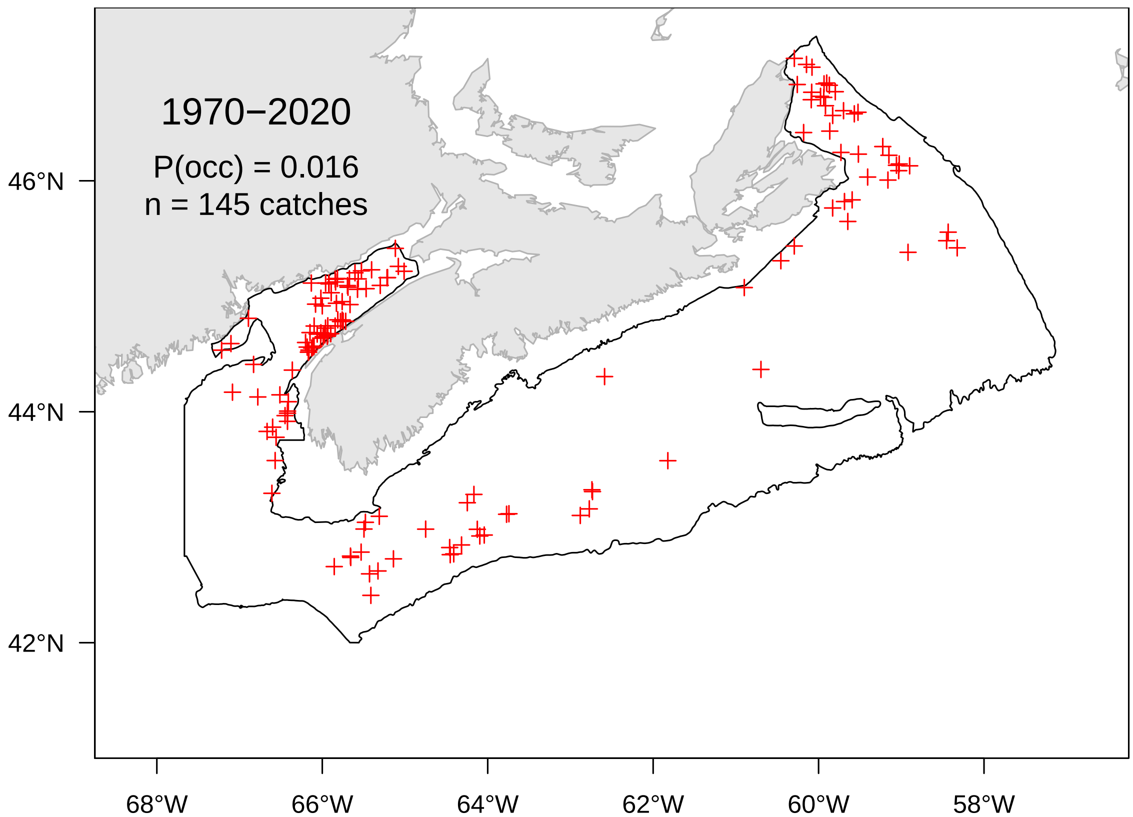



Figure 6.82A. Catch distribution for Radiated shanny.

### 6.83 Fourline snakeblenny (Quatre-lignes atlantique) - species code 626 (category LR)

Scientific name: Eumesogrammus praecisus

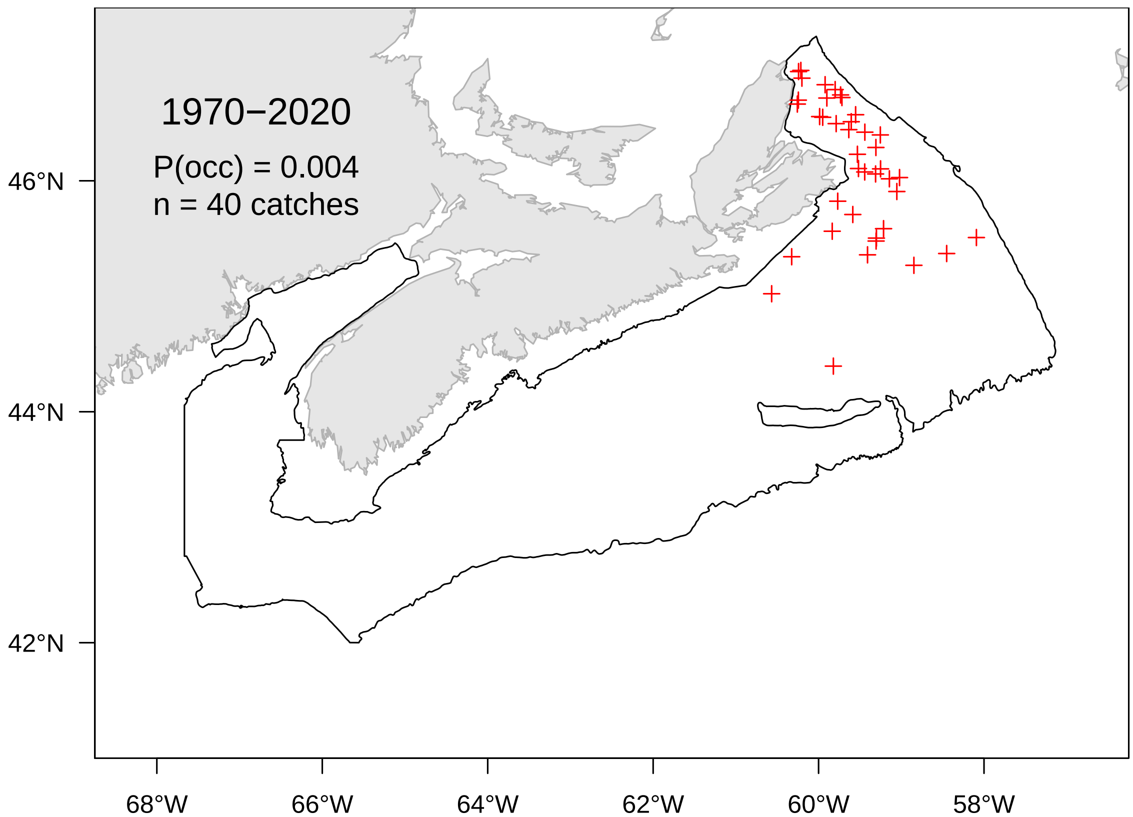



Figure 6.83A. Catch distribution for Fourline snakeblenny.

### 6.84 Wrymouth (Terrassier tacheté) - species code 630 (category LR)

Scientific name: Cryptacanthodes maculatus

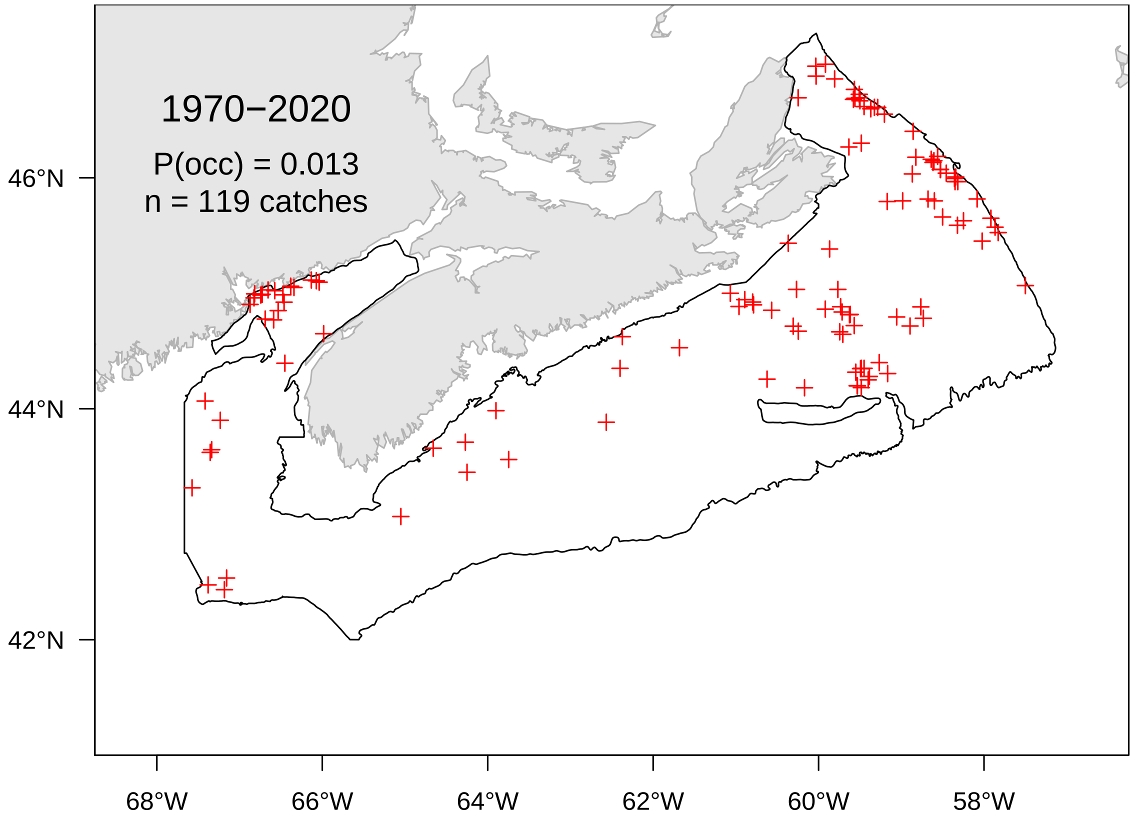



Figure 6.84A. Catch distribution for Wrymouth.

### 6.85 Arctic eelpout (Lycode arctique) - species code 641 (category LR)

Scientific name: [Lycodes reticulatus]

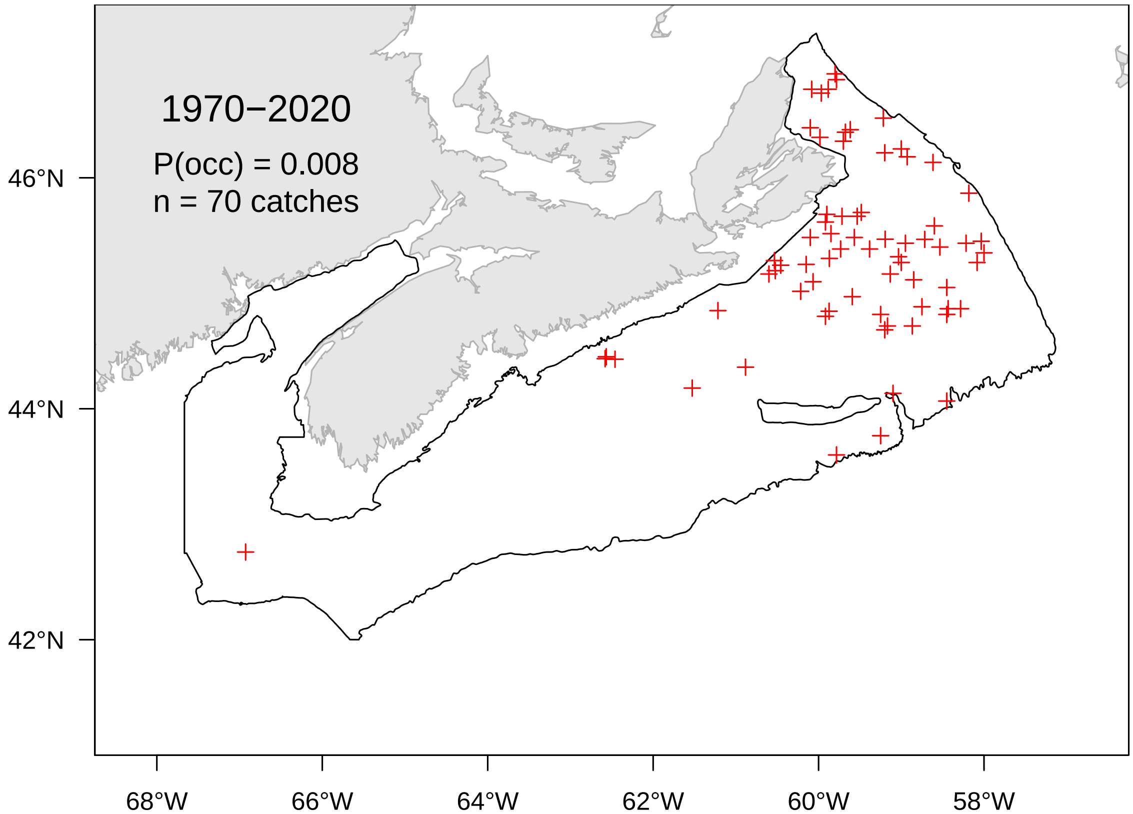



Figure 6.85A. Catch distribution for Arctic eelpout.

### 6.86 Atlantic soft pout (Mollasse atlantique) - species code 646 (category LR)

Scientific name: Melanostigma atlanticum

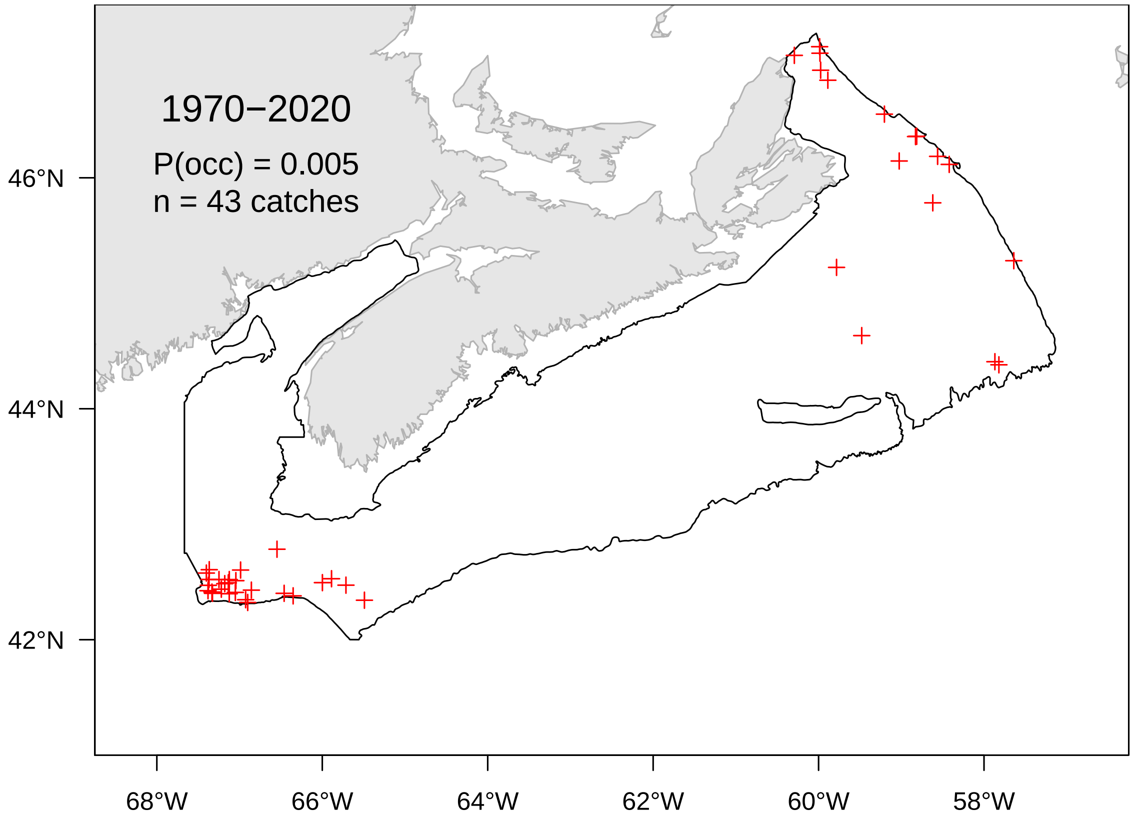



Figure 6.86A. Catch distribution for Atlantic soft pout.

### 6.87 Rainbow smelt (Éperlan arc-en-ciel) - species code 63 (category LR)

Scientific name: Osmerus mordax

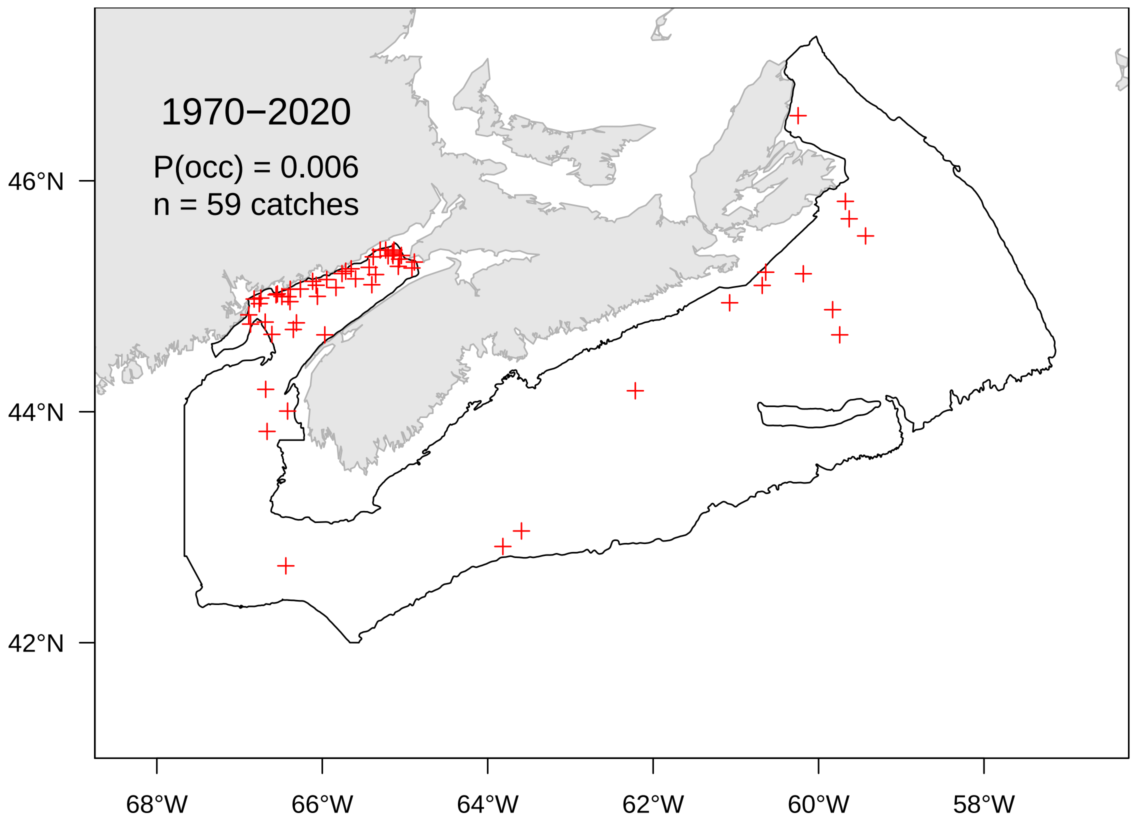



Figure 6.87A. Catch distribution for Rainbow smelt.

### 6.88 Longnose greeneye (Oeil-vert à long nez) - species code 149 (category LR)

Scientific name: Parasudis truculenta

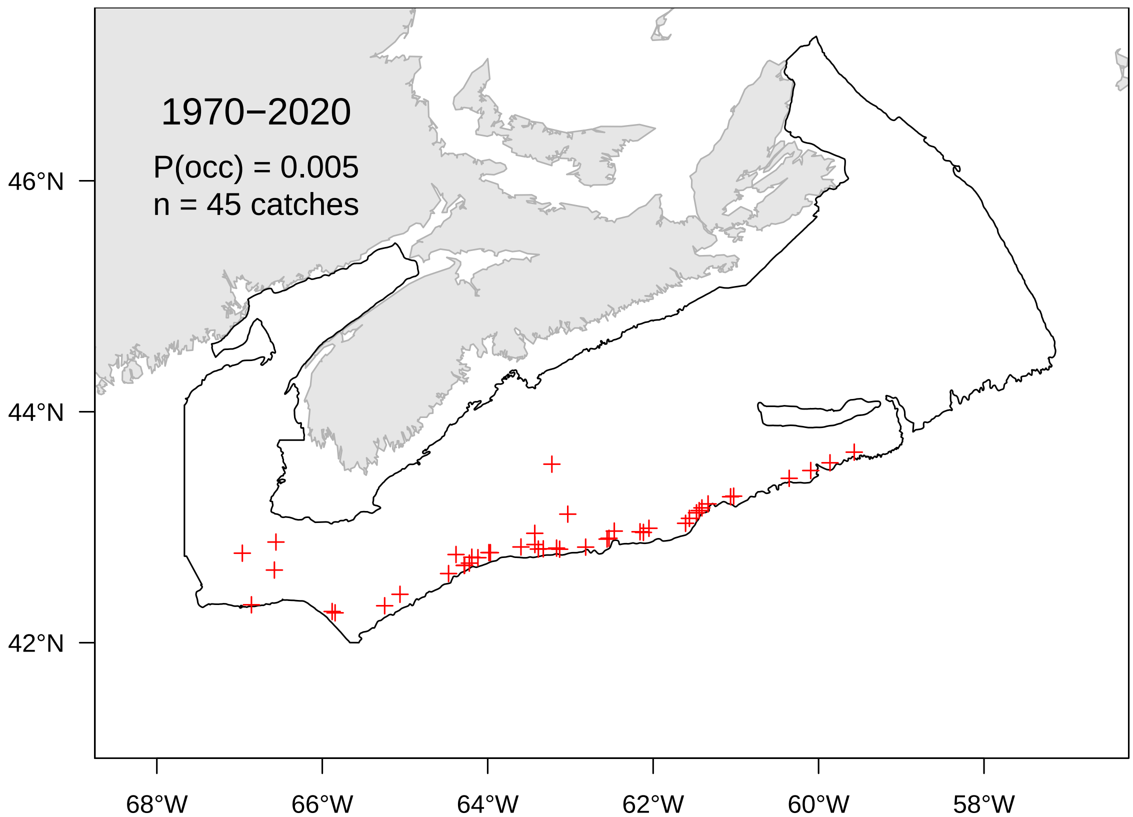



Figure 6.88A. Catch distribution for Longnose greeneye.

### 6.89 Shortnose greeneye (Éperlan du large) - species code 156 (category LR)

Scientific name: Chlorophthalmus agassizi

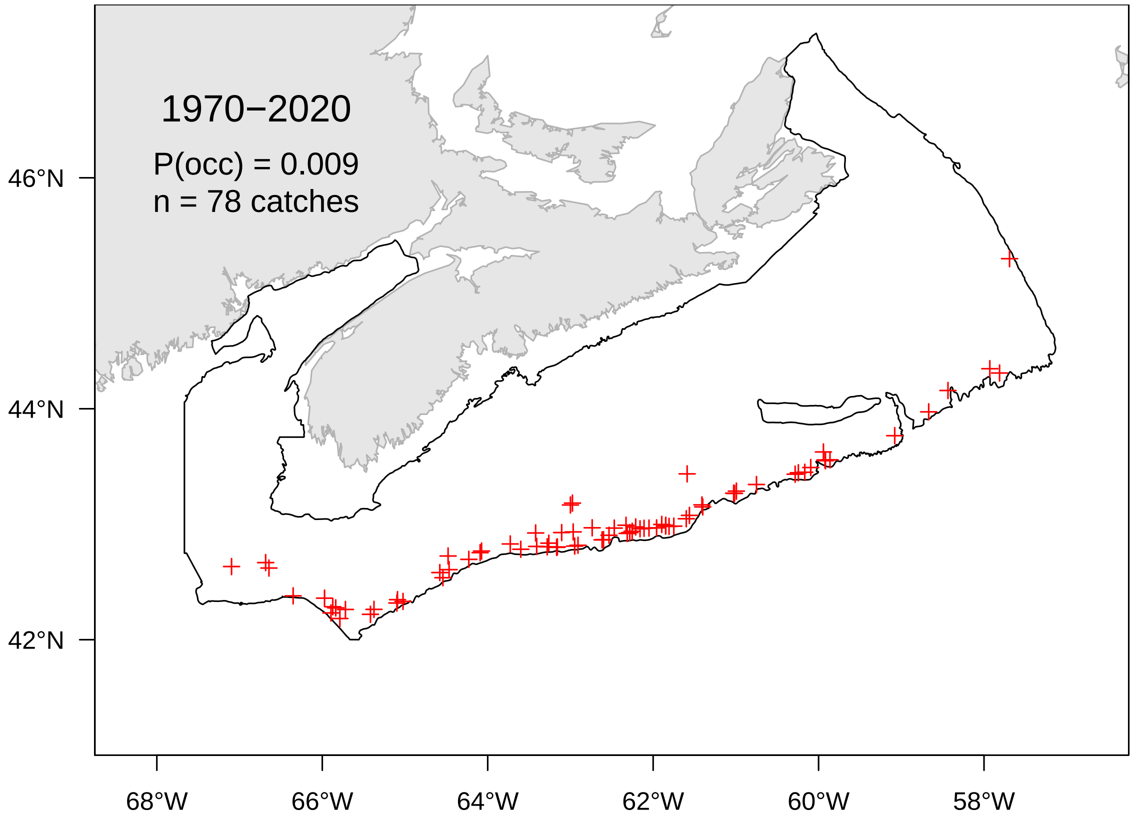



Figure 6.89A. Catch distribution for Shortnose greeneye.

### 6.90 White barracudina (Lussion blanc) - species code 712 (category LR)

Scientific name: [Arctozenus risso]

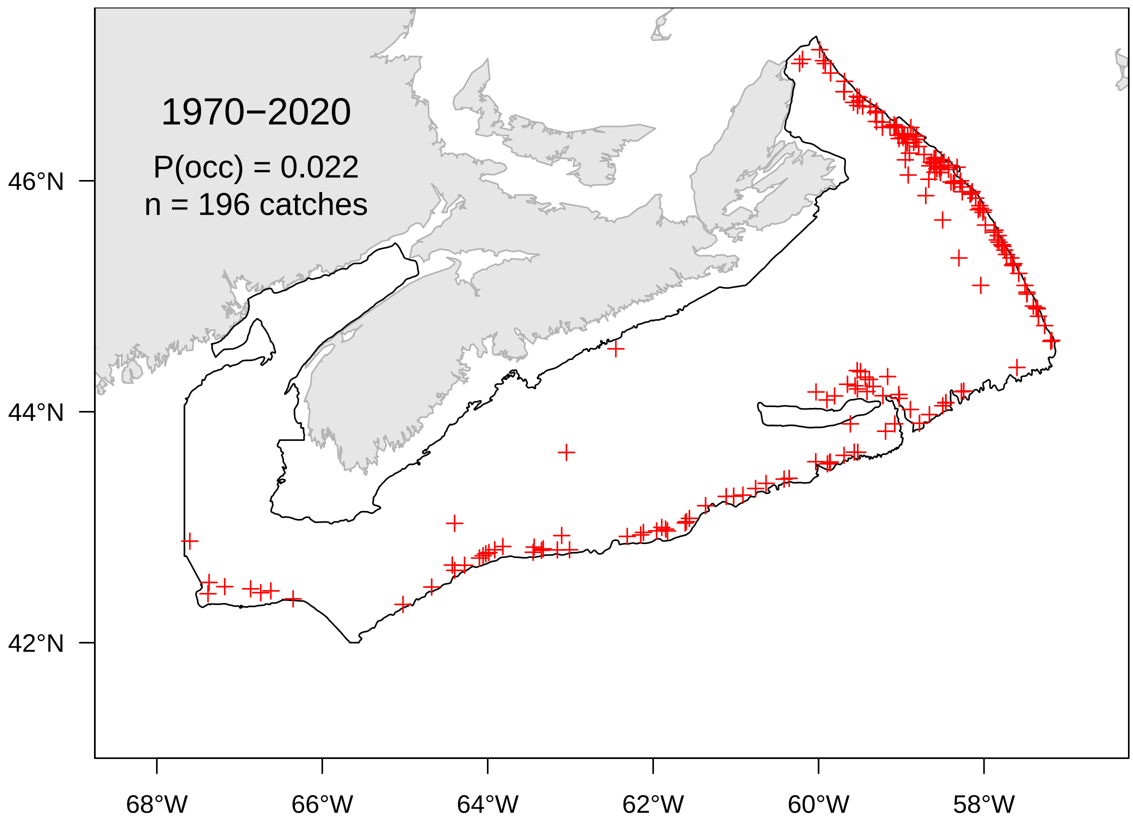



Figure 6.90A. Catch distribution for White barracudina.

### 6.91 Lanternfishes (Poissons-lanternes) - species code 150 (category LR)

Scientific name: Myctophidae

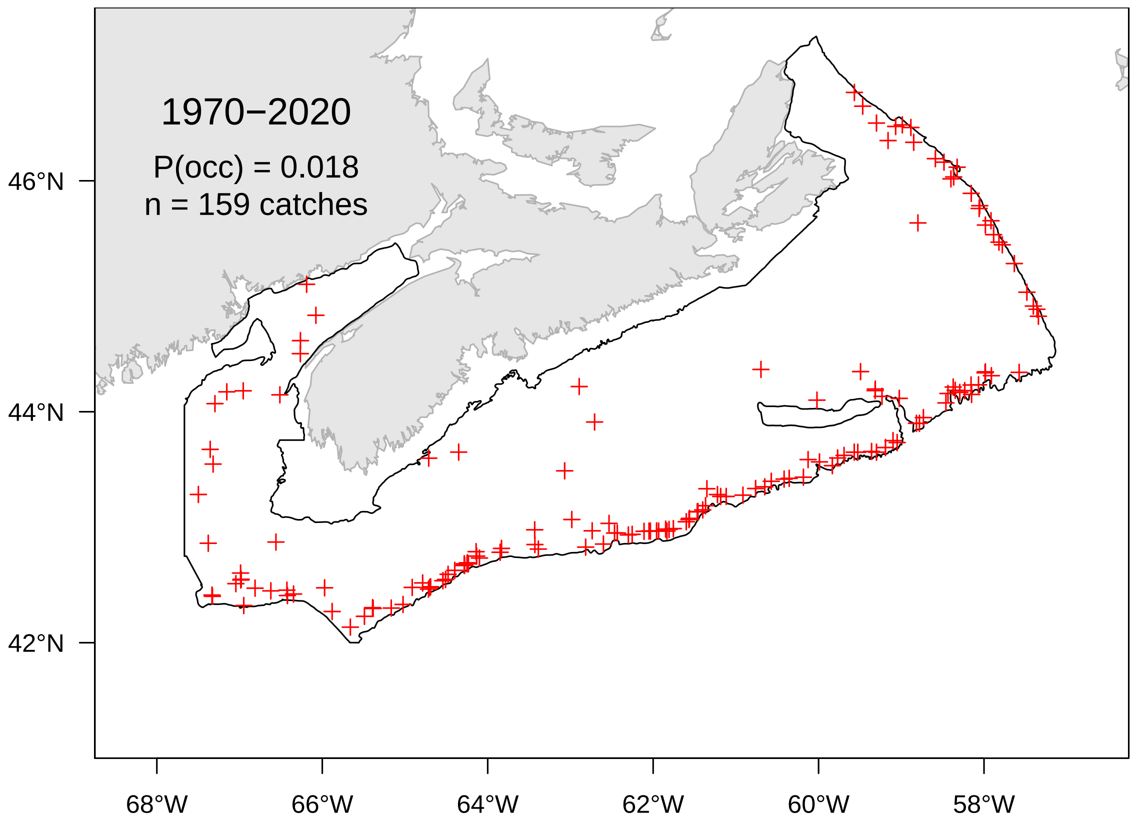



Figure 6.91A. Catch distribution for Lanternfishes.

### 6.92 Silvery lightfish (Brossé améthyste) - species code 158 (category LR)

Scientific name: Maurolicus muelleri

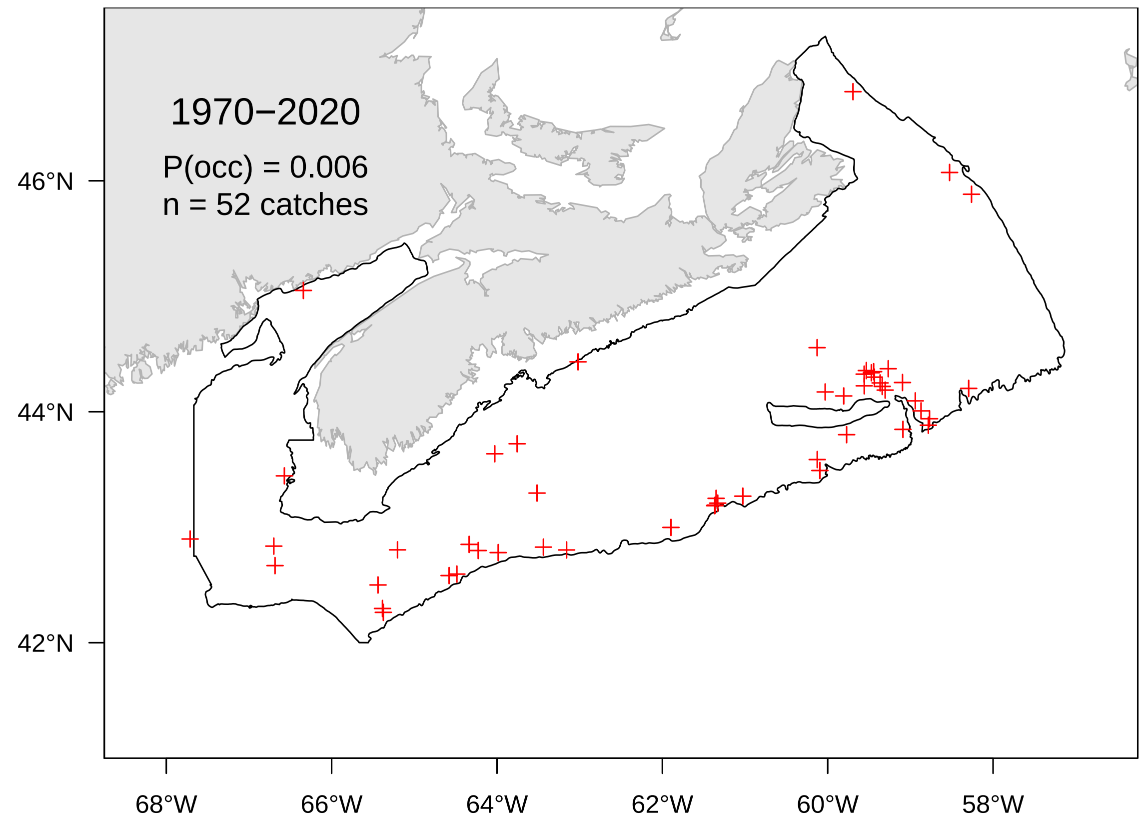



Figure 6.92A. Catch distribution for Silvery lightfish.

### 6.93 Boa dragonfish (Dragon-boa) - species code 159 (category LR)

Scientific name: Stomias boa

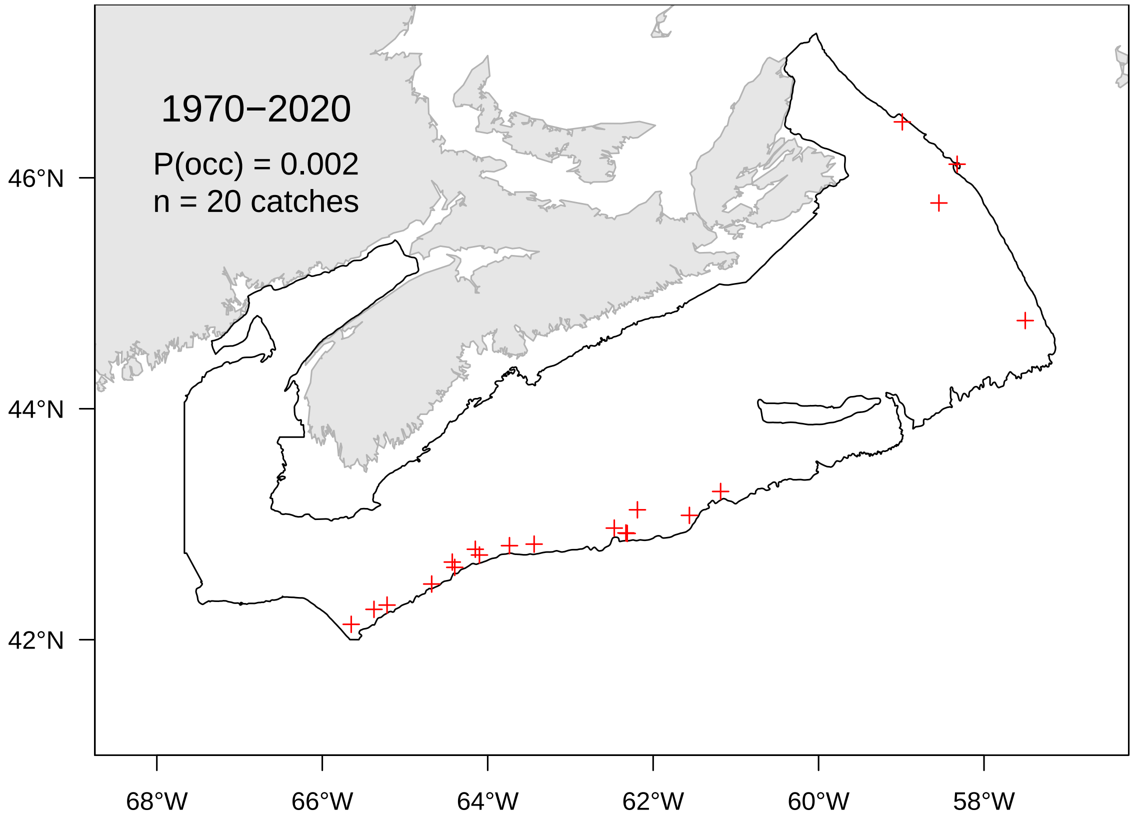



Figure 6.93A. Catch distribution for Boa dragonfish.

### 6.94 Hatchetfishes (Haches d'argent) - species code 741 (category LR)

Scientific name: Sternoptychidae

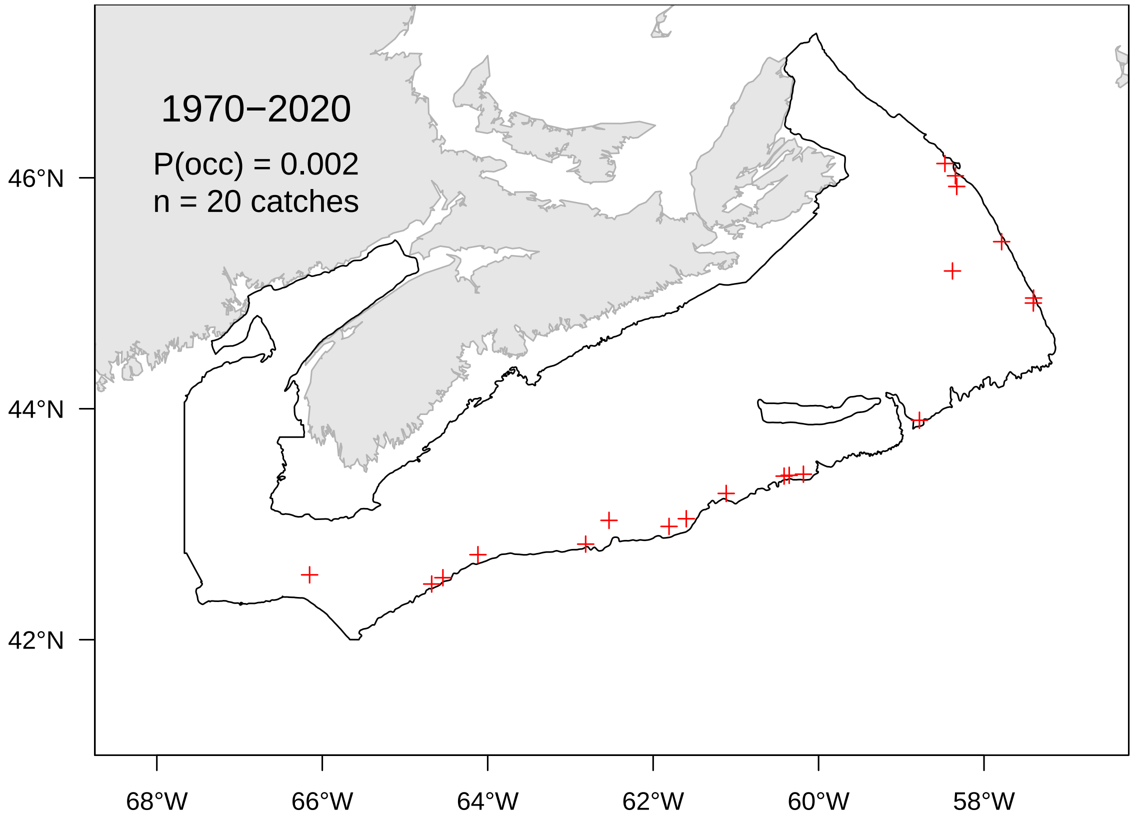



Figure 6.94A. Catch distribution for Hatchetfishes.

### 6.95 Atlantic batfish (Malthe atlantique) - species code 742 (category LR)

Scientific name: Dibranchus atlanticus

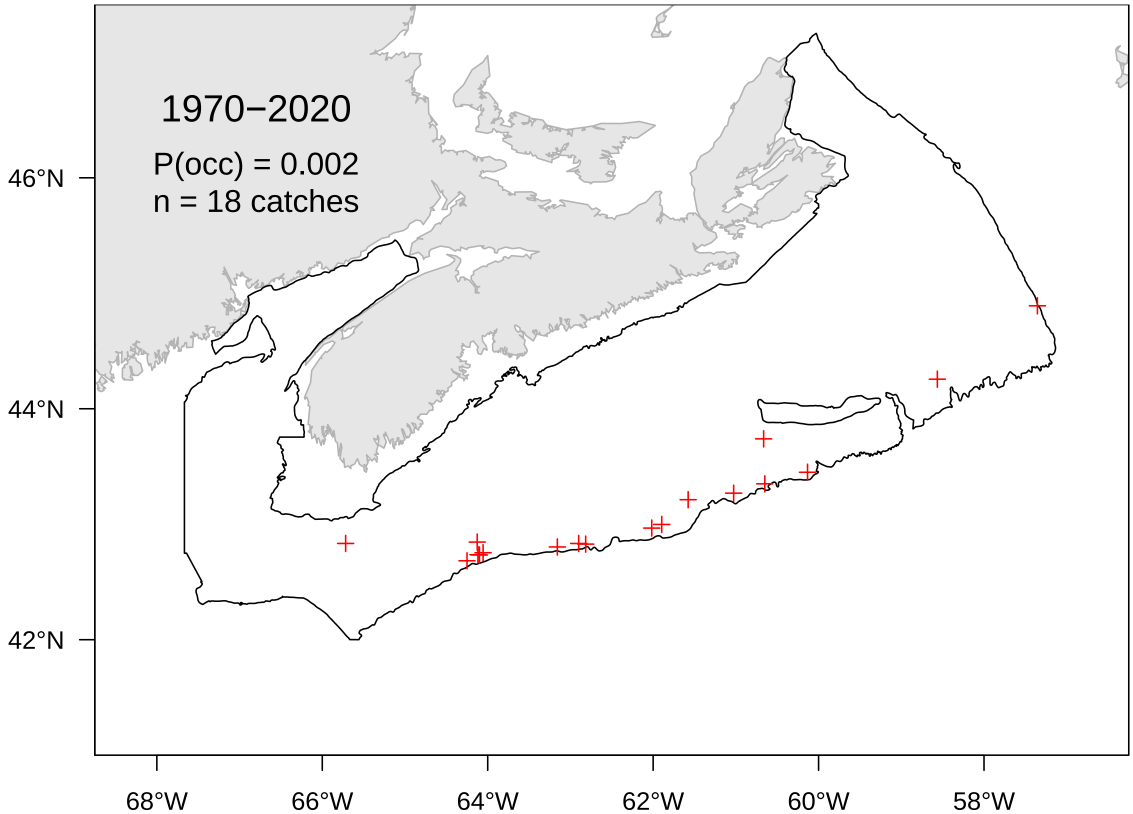



Figure 6.95A. Catch distribution for Atlantic batfish.

### 6.96 Slender snipe eel (Avocette ruban) - species code 604 (category LR)

Scientific name: Nemichthys scolopaceus

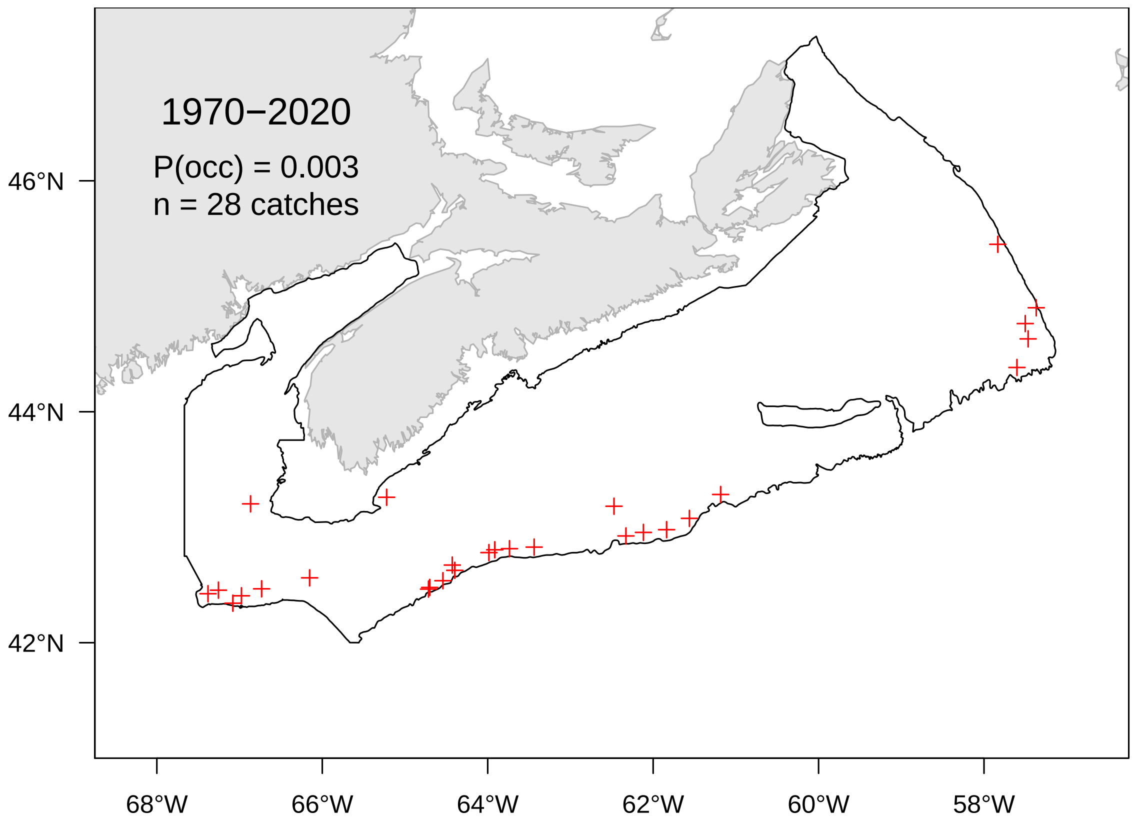



Figure 6.96A. Catch distribution for Slender snipe eel.

### 6.97 Silvery John dory (Saint Pierre argenté) - species code 704 (category LR)

Scientific name: Zenopsis conchifer

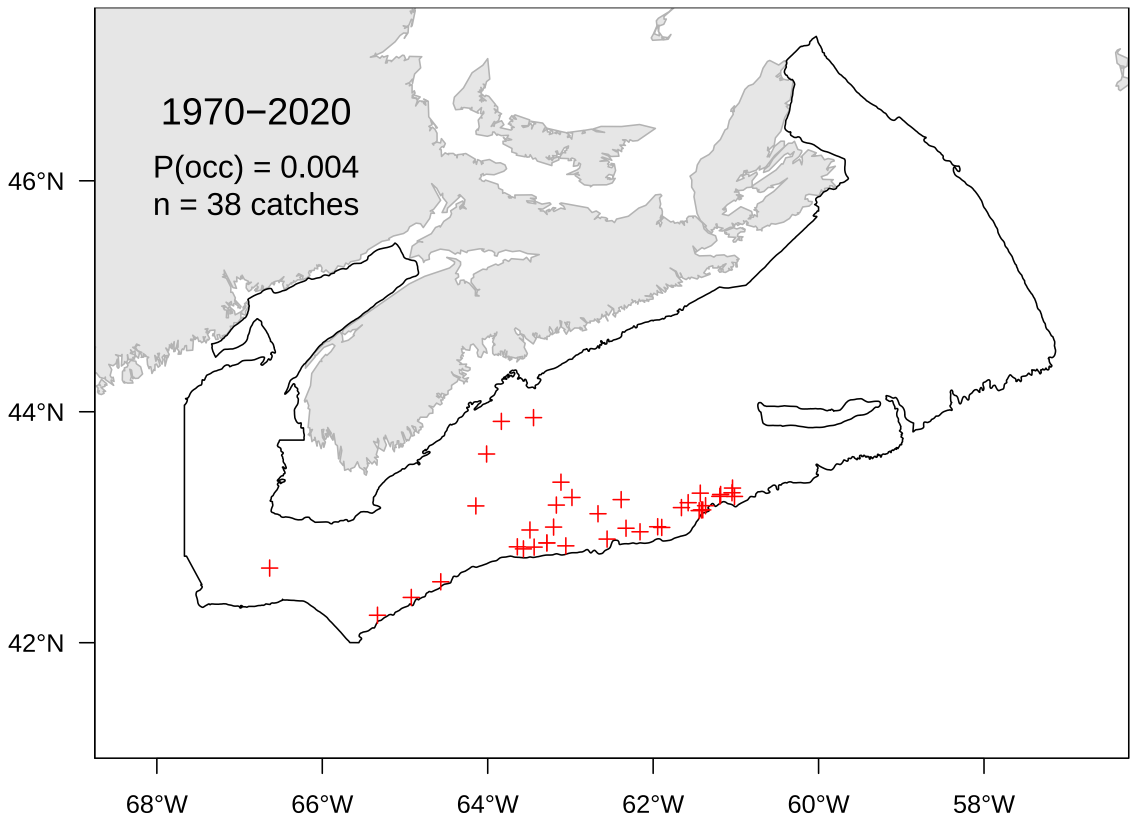



Figure 6.97A. Catch distribution for Silvery John dory.

### 6.98 Atlantic saury (Balaou atlantique) - species code 720 (category LR)

Scientific name: Scomberesox saurus

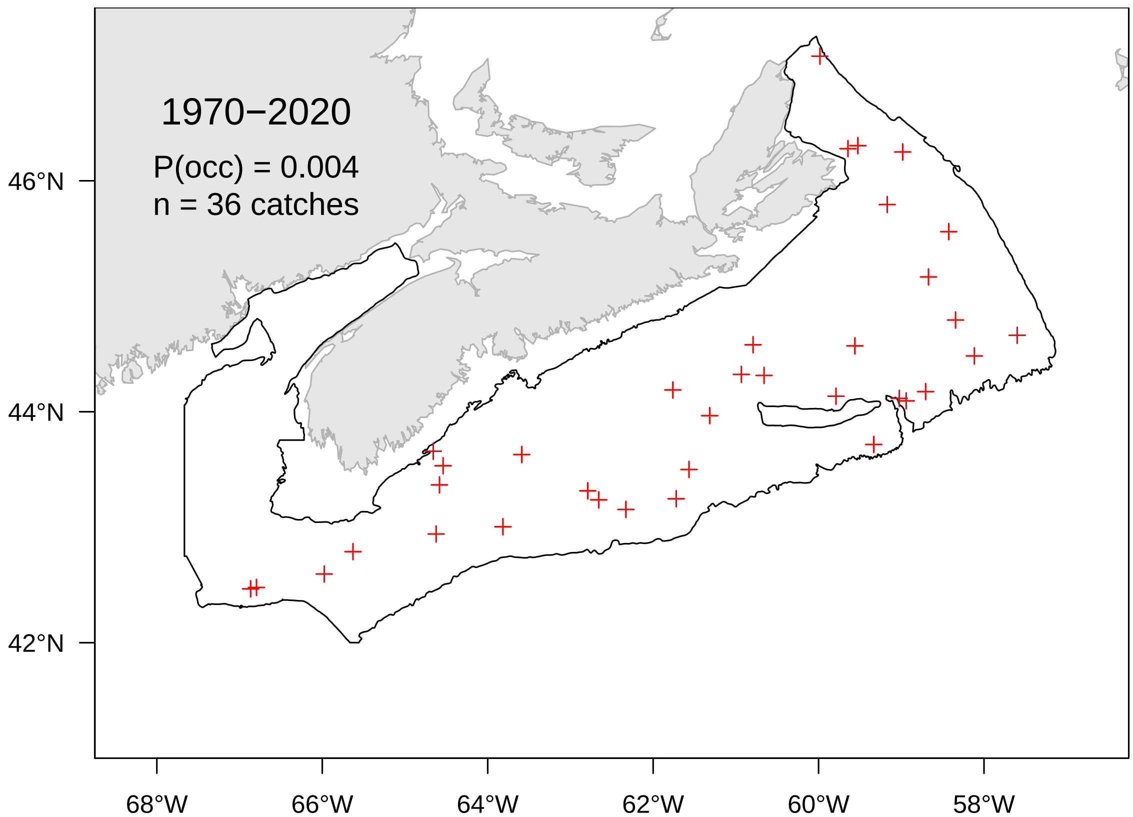



Figure 6.98A. Catch distribution for Atlantic saury.

### 6.99 Black dogfish (Aiguillat noir) - species code 221 (category LR)

Scientific name: Centroscyllium fabricii

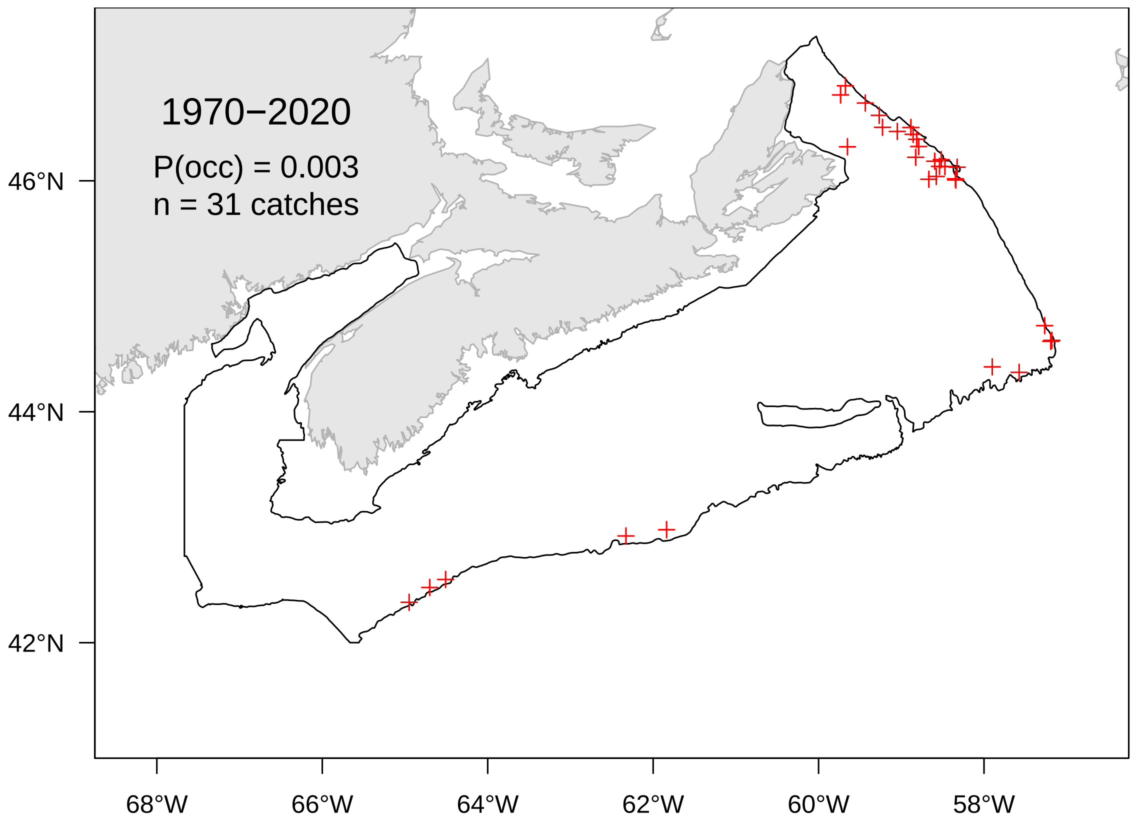



Figure 6.99A. Catch distribution for Black dogfish.

### 6.100 Longfin inshore squid (Calmar totam) - species code 4512 (category LR)

Scientific name: Doryteuthis pealeii

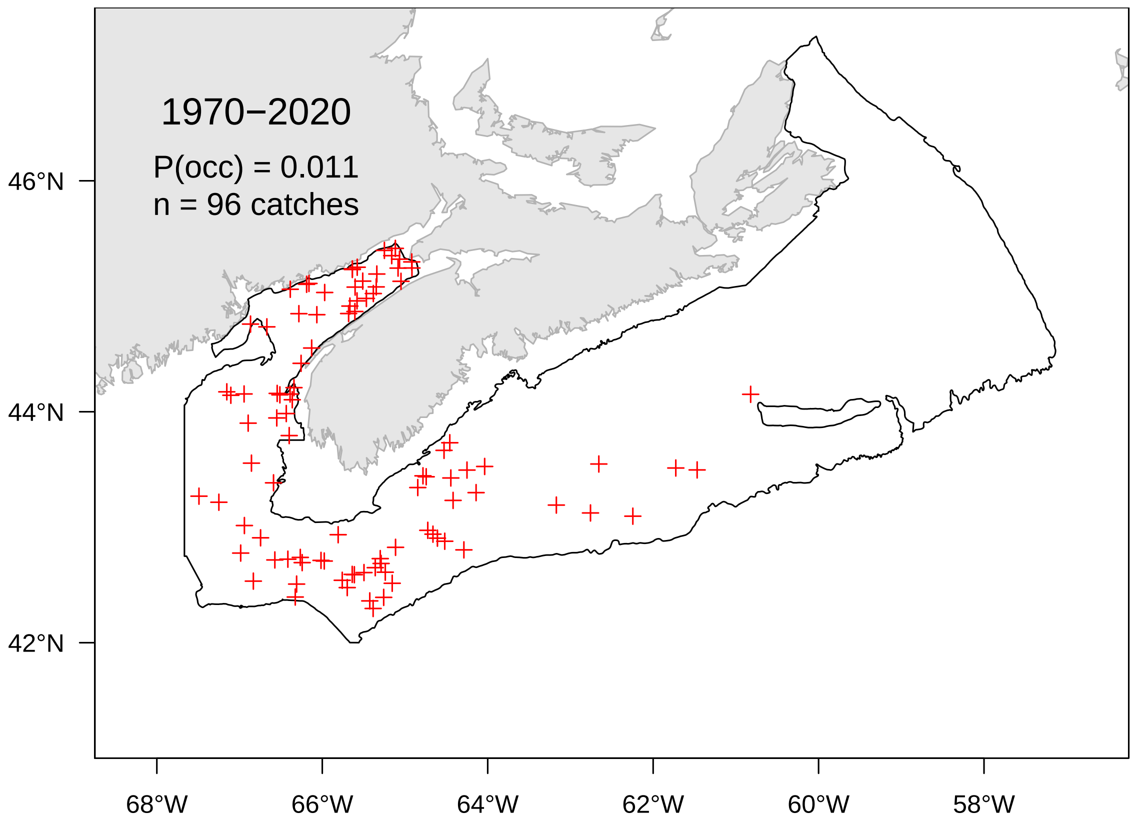



Figure 6.100A. Catch distribution for Longfin inshore squid.

### 6.101 Red deepsea crab (Crabe rouge) - species code 2532 (category SR)

Scientific name: Chaceon quinquedens

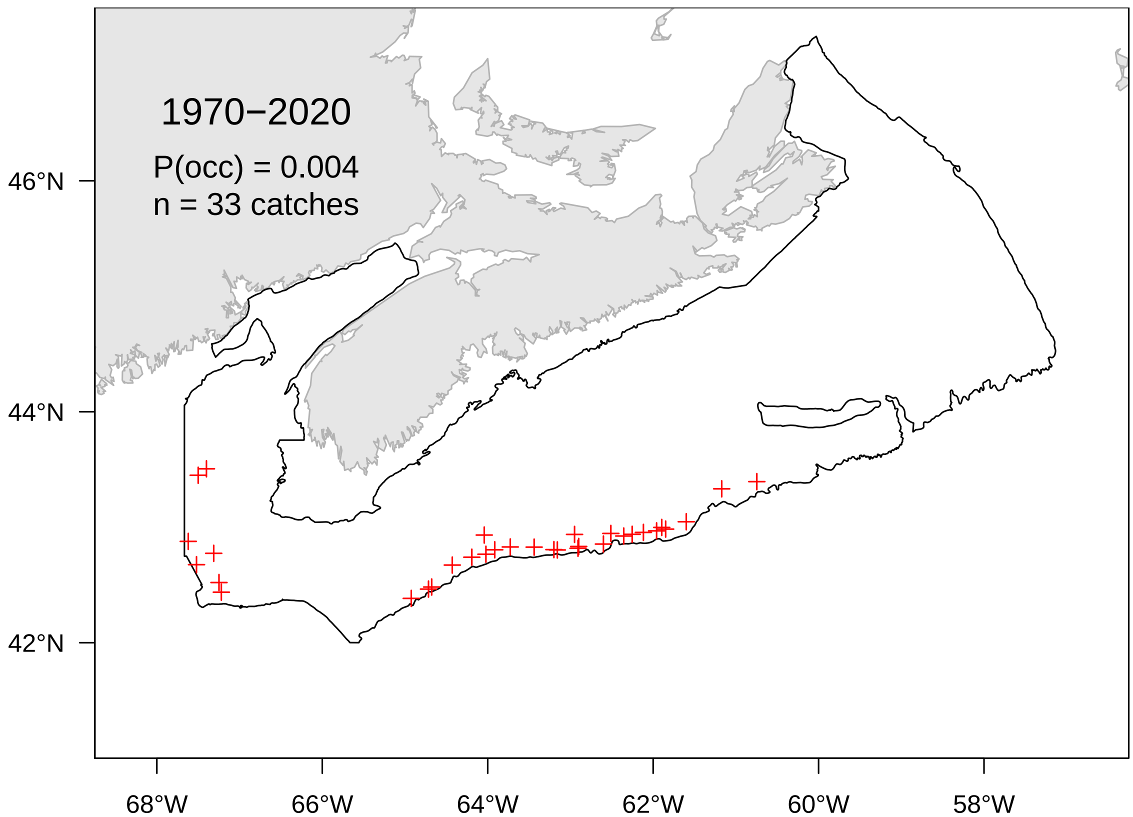



Figure 6.101A. Catch distribution for Red deepsea crab.

### 6.102 Cunner (Tanche-tautogue) - species code 122 (category LR)

Scientific name: Tautogolabrus adspersus

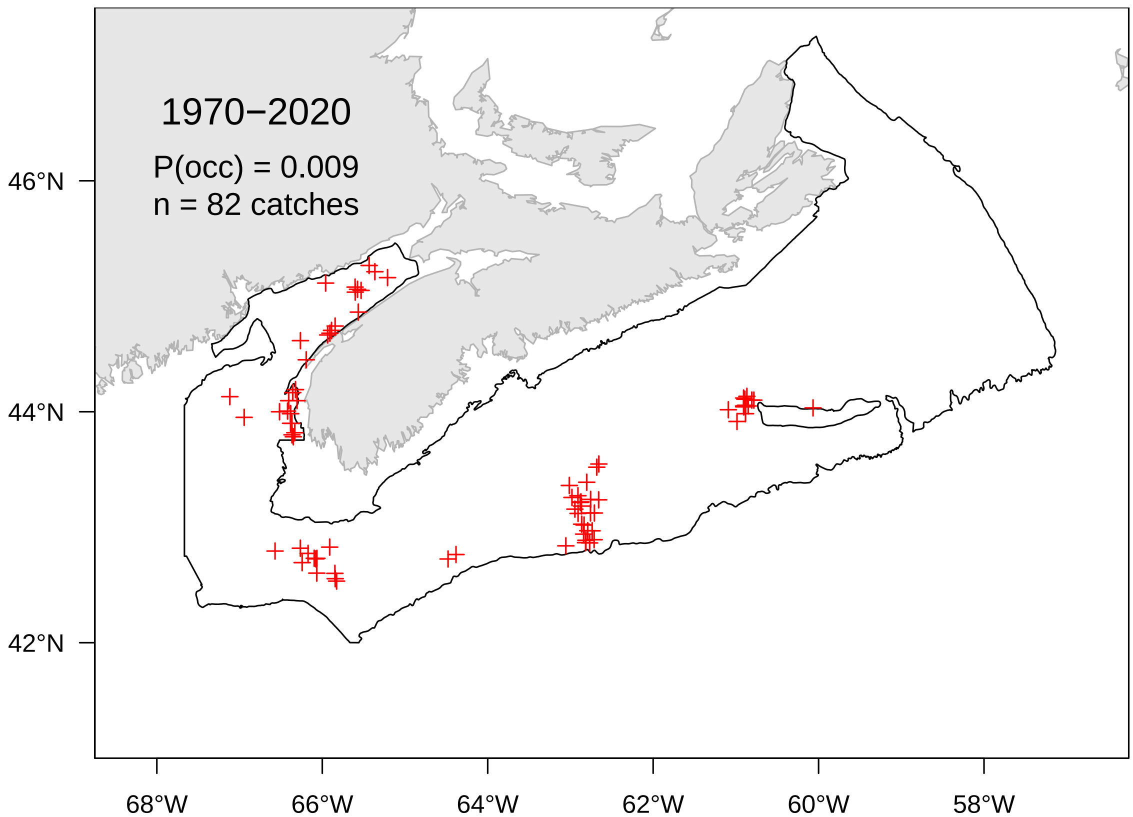



Figure 6.102A. Catch distribution for Cunner.

### 6.103 Spotfin dragonet (Dragonnet tacheté) - species code 637 (category LR)

Scientific name: Foetorepus agassizii

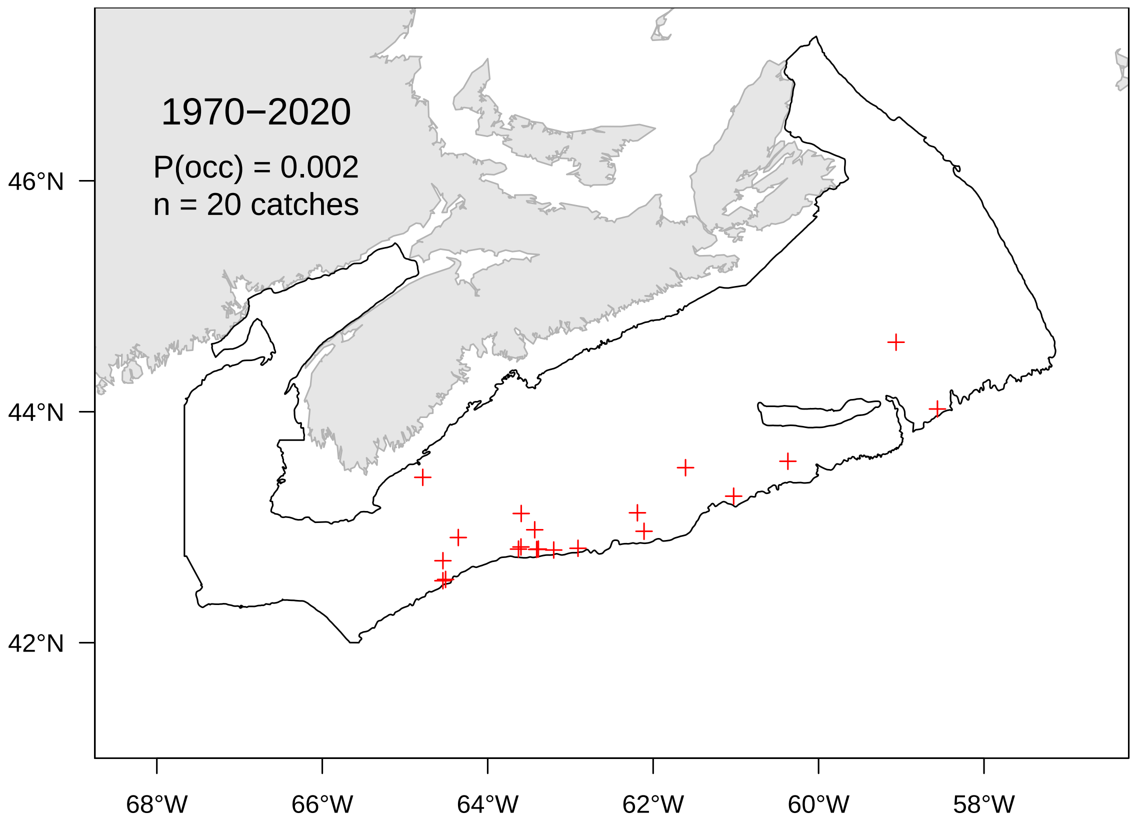



Figure 6.103A. Catch distribution for Spotfin dragonet.

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